Connecting Dots: Multiple Perspectives on Socio-technical Transition and Social Practices

Paolo Giardullo
University of Padova

Luigi Pellizzoni
University of Pisa

Sonia Brondi
University of Bologna

Giorgio Osti
University of Trieste

Paula Bögel
Karlsruhe Institute of Technology (KIT)

Paul Upham
Leuphana University of Lüneburg

Paula Castro
Instituto Universitário de Lisboa (ISCTE-IUL) and CIS-IUL

Abstract:. This Crossing Boundary hosts contributions accounting for experiences and theoretical perspectives which may look distant for how they address the socio-technical transition in the energy field but, we believe, when put in conversation, help common questions and tentative answers come to the fore. Giorgio Osti, Paul Upham, Paula Maria Bögel and Paula Castro have been engaged in reflecting on their respective disciplines in relation to socio-technical transitions. Recalling and valorising the STS basis of MLP and SPT in connection with other disciplinary approaches may contribute to enrich on one side STS debates and on the other empirical research on socio-technical transition in a historical juncture where such an endeavour looks definitely urgent.

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Introducing Some Dots

Paolo Giardullo, Luigi Pellizzoni and Sonia Brondi

Climate marches have come again to the forefront as expression of environmental movements. The issue of climate change is global and so are social mobilizations and actions that further stress the seriousness of the threat (e.g., Climate Networks and Fridays for Future strikes). To contain the effects of human influence on climate and the environment, mobilizations urge institutions at national and international level to act more effectively. Among the many actions required, a global energy transition from finite fossil-based to renewable zero-carbon systems is probably the most compelling and challenging. The toughest point is that fossil fuels contribute dramatically to climate-impacting emissions yet, besides being the dominant kind of energy source, are still an economically convenient energy source (Kerr 2010). Hence, far from entailing a univocal technological substitution, energy transition involves an encompassing reconfiguration of society, arguably implying a different social order. For instance, transition requires a shift from a rigid approach based on centralized governance and large-scale energy plants to a more flexible one based on distributed governance and small-scale energy production to increase efficiency and improve management of energy demand (Smil 2005, 2019; Sovacool 2016; Sarrica, Brondi and Cottone 2016). The pathway towards a different energy regime is undoubtedly a crucial ecological issue, since it can reduce the carbon footprint and limit detrimental mining and extracting activities; yet, it also implies significant political, economic, social and cultural shifts. Beside entailing a relevant geo-political shake-up, such a re-configuration is multi-layered (Geels et al. 2017), as it includes both technical innovations and changes in social practices, organizational life, markets, civil society and a variety of policies and institutions.

In the search for a more sustainable society and less climate impacting forms of energy production, distribution and consumption, the social sciences have contributed with relevant theoretical debates and empirical studies. Several comprehensive conceptual frameworks have been proposed to understand the multifaceted nature of the transition processes (Araujo 2014). Two important ones are the multi-level perspective (MLP) for the study of socio-technical transitions and social practice theory (SPT). Both these approaches build significantly on STS. Compared with other issues, however, the STS community has shown so far lesser interest in this theme, also when studying techno-scientific innovation. On the contrary, research from other disciplines, for example sociology of the environment, anthropology, geography, political sciences and social psychology, has produced valuable outcomes. Yet, studying the socio-technical transition towards de-carbonization can hardly ignore an STS point of view (Sovacool 2014). Such considerations led us to elicit reflections that can be useful to an STS readership. This Crossing Boundaries

section aims, so to say, to connect (some) social science dots – hence its title. More precisely, the following contributions present experiences and theoretical perspectives coming from different scholarships, which may look distant for their epistemological standpoints and ontological premises yet, we believe, if put in conversation, may highlight common questions and tentative answers. Namely, against the backdrop of the urgency and political relevance of assessing strengths and limits of a variety of moves toward an energy transition, we promoted an interdisciplinary dialogue between environmental sociology (thanks to the contribution of Giorgio Osti) and social psychology (thanks to the contribution of Paula Maria Bögel, Paul Upham, and Paula Castro). Of course, this is a restricted choice, in no way corresponding to the claim that these disciplines are the most relevant to studying this topic. We regard instead this Crossing Boundaries section as a conversation that has to continue and broaden. Valorising the STS grounds of MLP and SPT, on the other hand, may contribute to enrich both STS theoretical debates and empirical research. In this spirit, we asked the invited authors to reflect on the way their respective disciplines address socio-technical transitions.

As developed by Geels (2002), on the basis of a first formulation of Rip and Kemp (1998), MLP approaches socio-technical transition by distinguishing analytically three social levels, corresponding to different spatial and organisational scales, from micro to macro, and provided with different degrees of stability, which account for how socio-technical innovation trajectories develop: i) niches, sufficiently protected from socio-technical pressures, where innovation can spring out; ii) established socio-technical practices based on norms, institutions and material infrastructures, which constitute relatively stable regimes, and with which innovation has to engage if it is not to remain confined in niches; iii) an "exogenous socio-technical landscape" consisting of a set of heterogeneous factors (Geels 2011). Landscapes include external conditions such as environmental constraints, as well as normative and cultural norms. These constitute the most durable and hard-to-change context of socio-technical regimes (Geels 2002). Beside evolutionary economics and neo-institutionalism, MLP builds on the Dutch tradition of social studies of science and technology; consistently with its origins, it has been applied to understanding socio-technical transitions, looking at these from a co-evolutionary outlook. MLP has been applied to account for individual mobility, the trajectory toward steamships and the development of airplanes engines (Geels 2005). It has been successfully applied as well to the energy sector, for studying the transition towards sustainability. Moreover, it is recognized as a valuable framework for policy-oriented research (Hargreaves, Longhurst and Seyfang 2013). SPT, at least in the guise promoted by Shove, Pantzar and Walker (2012)[1], conceives of practices as a unit of analysis. A practice is to be distinguished from single actions, as it consists in a nexus of repeated actions and social life arrangements. So, practices exist only in relation with others and emerge as such

when their components – skills or abilities, technologies and artefacts, and symbolic meanings – are connected (Shove and Walker 2007). SPT is popular among scholars engaged in a variety of fields (Hui, Schatzki and Shove 2017), yet, as noted by Warde (2014), sustainable consumption is a research topic which not only is dominant but has led to theoretical developments whose relevance extends well beyond this particular issue. Such version of SPT is micro-oriented, addressing how social dynamics are reproduced and can be disrupted through new arrangements emerging between material elements, such as technological artefacts, skills required to use them and the symbolic value they bring with them (Hargreaves 2011).

In spite of some connections, MLP and SPT are considered as competing outlooks (Hargreaves, Longhurst and Seyfang 2013), since their basic approach differs. MLP privileges a vertical perspective that moves upstream from niches of innovation to broader changes. In this regard, it aims to reply to criticisms addressed to STS prevailing micro-focus on socio-technical change, for its failure in providing an encompassing picture to the benefit of an analysis of relatively closed, local contexts (Geels 2002, p. 1259). However, MLP ostensibly meets with some limitations. For example, it has been criticized for its insufficient consideration of the role of materiality, of the dispersed and uneven distribution of agency and power, and of the importance of the historical, spatial and political context (Avelino et al. 2016). Other criticisms stress that the assumption that innovation follows a vertical trajectory leads to an excessive focus on institutions. Furthermore, MLP typical work on secondary analyses of official data may represent a methodological weakness. By connecting these criticisms with sustainability issues, moreover, inconsistencies and ambivalences emerge, especially regarding the renewable energy sector. Brand new regimes do not always fulfil their promises at local level (Scotti and Minervini 2016); conversely, niches do not necessarily promote a detachment from existing regimes (see e.g. Schreuer 2016).

SPT, in its turn, looks mainly at the horizontal circulation of different components of human activities (Shove 2012). As a result, a critique, mainly coming from MLP scholars, is that studies of practices are "highly contextual, and often developed in response to local problems" (Geels 2019, p. 7). Consequently, SPT analyses of sustainability transition do not take particular care of the different scales at which local processes take place, concentrating chiefly on everyday life (Welch and Yates 2018).

Attempts at integrating between MLP and SPT have been already proposed for instance, at a theoretical level, by Geels (2011) and Raven (2012). Others have re-analysed MLP case studies adopting an SPT outlook and vice versa (Hargreaves, Longhurst and Seyfang 2013). The take-home-message, here, is to refuse ontological partisanship. Indeed, researchers may profit from considering both vertical and horizontal trajectories of innovation, as favouring one does not necessarily entails neglecting the other. Taking these elements together, one can see additional

room for discussion, not only concerning the scale on which to focus, but also what to look at and what type of processes one is aiming to disclose. Through this Crossing Boundary section, we aim to expand these issues in interdisciplinary terms, according to an STS sensitivity for socio-material connections. We refer to the role of non-human agents, from infrastructures to devices for energy consumption monitoring. These have a crucial relevance both because of the path dependency they contribute to generate, as Osti's paper stresses, and because "delegation" to new technological tools implies social control. Osti elaborates on the opportunity of merging social sciences with the hard sciences that deal with energy issues; apart from the already mentioned role of material elements, he looks at the study of social practices as instrumental to enhancing the significance of the social relations implied in the energy transition. A risk in studying these questions he underscores is of plunging into renewed forms of determinism. It is easy, and sometimes convenient in analytical terms, to depict the individual as a purely rational actor; indeed, there is plenty of literature devoted to how behaviour can be oriented through scripts inscribed in technical objects and their arrangement in social spaces (see for example the "nudge" approach: Thaler and Sunstein 2008). Along this way, however, one falls into a well-known technological reductionism.

Social psychology can contribute to overcoming rationalistic perspectives as well: in particular, cognitive and behavioural approaches have provided useful insights in this direction. However, such approaches suffer from being focused on individual-level issues (e.g. attitudes, emotions, motives). The contribution of Upham, Bögel and Castro highlights lines for further development in the understanding of the subjective experience of individual actors and groups imbricated in the energy transition processes. Their point concerns the need to achieve a more comprehensive understanding of the individual-society link. A more co-generative vision of social changes lies in social representations and identity theories. In particular, these theories may complement the SPT approach, since they focus on psychosocial processes, going beyond the individual level, and fostering the vision of individuals as agents of transition rather than passive recipients. Moreover, an integrated reading of these different theoretical approaches allows for a better comprehension of the role of the material world and its components as well as their appropriateness in everyday life.

There are several open questions, which the papers contribute to highlight: for instance, how to apply a flexible approach instead of aiming at a grand theory. The study of practices, in this sense, is promising; however, it is seldom used for comparative studies. As the next sociotechnical transition is likely to be first of all centered on energy, future research on this subject looks definitely urgent.

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Above, Beside, Under: Three Ways Social Technical Disciplines Can Work Together in the Energy Transition

Giorgio Osti[2]

Introduction

Experts with different backgrounds often face together inextricable energy issues concerning pollution, geopolitical unbalances, and conflicts with local populations. They broadly agree on the necessity to adopt a multidimensional approach (Freunek Müller et al. 2015), but they rarely discuss how knowledge is developed and shared.

Thus, it is useful to elaborate some points for a reciprocal contribution between social sciences - more specifically sociology - and disciplines that have direct involvement with energy management. The latter are usually specialisations of engineering (Goldblatt et al. 2012). In this essay, they will be identified for convenience as technical disciplines.

The aim of this paper is to frame the relationship between social and technical knowledges of energy transition. The temptation of reductionism is strong, even for disciplines, such as spatial sociology, that consider themselves systemic (Rutherford and Coutard 2014). We will neither ar-

rive at a unique methodological approach, nor at a 'recalibration of various scientific hierarchies' (Asdal and Marres 2014, p. 2056). The relationships between social and technical disciplines are and have to remain 'plural'. The dream of a grand theory including any kind of knowledge has to move forward.

The paper deals with three ways social sciences and techno-sciences match in the attempt to enact environmental change (Asdal and Marres 2014). The reciprocal position of social sciences and techno-science will be illustrated with three spatial metaphors: above, beside (or in between), and under. Distinct attention is given to some perspectives included in this Crossing Boundaries section: spatial forms, material actors, and social practices. The last one is probably the key for representing the energy transition in a more relational way, overcoming the limits of both holistic and atomistic analyses. This sentence will be qualified thanks to further middle-range categories proposed here, namely monitoring, sharing, playing with energy: their application will be the final result of the paper.

Above, Beside, Under: Three Ways Social and Technical disciplines Can Stay Together

A broad justification for dealing with relationships between disciplines in a plural way comes from the observation of widespread phenomena related to energy issues. We often note that the latter are framed according to geopolitical schemes; they are a vital resource for winning wars and assuring the economic development of countries (Tidwell and Smith 2015). The role of energy sources for national security is indeed essential; thus, their exploitation has to be put as a dependent factor of other, more powerful processes. Socio-political disciplines then deal with specific knowledges about energy extraction, distribution, and use from a more general standpoint. We may call it the 'above' position.

A less widespread position can be called the 'beside' or 'in-between' one. Immediately after the launch of public schemes for subsidies, renewable energy sources (RES) became an industrial sector, growing in the market but necessarily cultivating connections with public policies and institutions. Indeed, any new electric device needs public authorisation. For this reason, energy transition raised a great number of interest groups pressing authorities for permission and support. In this case, the socio-political sciences are beside or in between the technical ones.

The third outlook social sciences offer to techno-sciences in relation to energy issues can be called 'below' position. It is exemplified by the great support socio-psychological disciplines provide to economic choices of consumers. The individual demand of energy is only apparently linked to natural needs of comfort. It is instead filtered by comparisons with other consumers and a variety of ergonomics that take the name of home automation (*domotica* in Italian). In this case, the social sciences provide information useful for adapting technical devices to consumers' tastes.

The 'above' perspective is endorsed by relevant scholarships. To mention a few of them we can include: i) The cognitive frames that are relevant for accounting for the embeddedness and social epistemology (Yasunori, Walsh 2010) of energy transition (Osti 2012). ii) Political ecology which provides a robust framework in order to locate struggles for energy within a more general conflict of capitalism with actors opposing its tendency to expropriation and exploitation of land and labour (Sovacool 2016). iii) Energy as first mover of society: indeed, there was a moment in the history of sociology when energy was considered as an essential component of social functioning (Carrosio 2014). Ecological approaches based on resources and population can be inserted as well in this vision of energy.

To give a further example of the 'above' approach, we can use two controversial Dutch cases, one project concerning shale gas extraction and the second about the capture of CO_2 as studied by Pesch et al. (2018). The authors identify three types of justice claims concerning both the projects — distributive, procedural, and based on recognition — and two types of trajectories for their assessment:
- overflowing (formal trajectory embedded in the legal system)
- backflowing (informal trajectory mainly embedded in public discourse and grassroots mobilisation).

The claim based on the struggle for recognition of local public resistance (that entails dignity, respect, identity, etc.) is the most neglected, but it is of high efficacy for both an understanding of the events and the capacity to mobilise people. According to Pesch and colleagues (2018), there is an ongoing and fertile passage between formal and informal types of assessment, whose effect is the scaling up of controversies toward the national level (see other cases in Pellizzoni 2011). In fact, after these conflicts, the government has changed the procedure for environmental assessment of large-scale works (Pesch et al 2018, p. 831).

A connection between the already mentioned frame-based approaches and those based on political ecology is further noteworthy. For example, Franklin and Osborne (2017) adopted the same typology of justice claims. But they used it for ideological reasons. They argued that the argument about the financial burden of photovoltaic panels, since their installation is not affordable for poorer households, serves the private local utility to cover its own interests for fossil sources of energy. In this sense, the Marxist concept of ideology makes this technical procedure comprehensible within a larger framework. Even though they offer a consistent perspective, these 'above' approaches present some limitations. Both political ecology and cognitive sociology make holistic claims, but they neglect the power of relationships (see debate in Wagenaar and Bartels 2016). These can modify both the recognition process (it is possible that a participatory process itself raises the issue of local identity and dignity) and the relations of production. For example, utility workers, usually the weaker side in labour relations, become stronger in the negotiation and

press the managers to leave dominant fossil sources. A well-organised association of consumers can counteract and change the terms of energy trade. Usually, the 'above' frameworks are rigid, conceiving material interests or cultural values as immovable data. The application of iterative approaches, primarily by scholars, can modify these fixities, giving more agency not only to weaker social parts (e.g., the local population) but also to manufactures and infrastructures' management. Micro-wind turbines are generally more acceptable than big ones. If local people oppose giant wind farms, the energy company may opt for introducing smaller turbines (which have their own logic of action).

The 'beside' approach needs a brief introduction. It deals with the position of the social sciences in between advanced technical systems. The basic idea is the existence of organisational fields developing through sets of institutionalised rules (neo-institutionalism of DiMaggio and Powell 1991; on energy issue, Fuchs and Hinderer 2014). However, such fields do not depend passively on external general systems as previous approach does. Rather they multiply, specialise, and equip themselves with some sort of self-government, self-learning, and self-celebration (Lidskog and Sundqvist 2018).

All these 'selves' provide good and cost-effective functioning, but they raise the need for professional transactions with other systems. Rarely is an energy system completely self-sufficient. Bad or rarefied relationships with other systems cause a lot of problems (transaction costs). Thus, communication systems have to be created in between. To think this can happen automatically or only thanks to the installation of sophisticated ICTs is an illusion. The fulfilment of so-called energy sector *unbundbling*, which should be able to break the old monopolies, requires new companies specialised in human and social communication. Of course, these intermediate actors adopt other ICTs; see, for example, the electric market, which works like the stock exchange.

MLP, also called 'theory of transition', is frequently used in the energy sector. It can be considered exemplary of the need for social 'bridges' between separated institutionalised fields. Geels (2010) portrays the real world as a set of fields – landscape, regime, and niches – with different levels of organisation, recognition and, finally, closure to external forces. Change happens when a specific project aligns one system with another, creating a socio-technical innovation. In this kind of approaches, the simplest case is the alignement of innovation niche to socio-technical regime (Schot and Geels 2008).

A famous retrospective research is the transition from horse-drawn carriages to automobiles (Geels 2005). Geels (2005) shows that several socio-political systems intersect with the rise of modern mobility systems, in particular, new consumer tastes and windows of opportunity for normative change. His approach is fully socio-technical. Automobiles are thus not only an efficient way to move, but also a means that allows the interaction of four specific social needs: the need for personalised

transport in terms of destination and privacy (avoiding contact with other passengers); the need for moving outside the city for recreation (picnic); the need for organising new racing fields; and the need for connecting people living in suburbs or on farms. These niches coalesce in favour of small autonomous means of locomotion, whereas an *omnibus* – a collective means of transport – clearly does not match with the individualised needs for spatial mobility.

Geels (2005) recognises there is no perfect alignment of fields, showing that the multilevel pattern works also in deviant cases. He notes a long co-existence between horse-drawn carriage and automobile regimes. In general, we think of simple substitution, but sometimes transfer prevails: the company making carriages starts installing engines in them. Intermediate systems emerge in between the niche and the regime; thus, electric trams were working for a long period after private automobile affirmation and today they know a renaissance.

Ultimately, MLP, even if more flexible than holistic or 'above' models, still follows a sort of *ecological and institutional functionalism*. Indeed, such a model proposes a population ecology of organisations that are mutually interdependent and variably recognised by institutions (Hannan and Freeman 1977). In this regard, interdependency is based on mutual satisfaction, while public recognition happens because of adaptation to rules, principles, or customs.

The double contingency of relational approaches (Donati 2010) and the idea of role distance typical of dramaturgic allegory (Goffman 1961) provide a fruitful terrain for critique. In MLP, actors are almost absent; we talk of population according to ecological models. Thus, agency is neglected, including the possibility of a range of reactions from actants, such as material objects, and socio-technical configurations (Walker and Cass 2007). In the study on private car diffusion, it is easy to imagine a socio-technical system formed by a driver and his/her own car, almost indistinguishable from one another. Yet, the diffusion of the self-driving car is bound to change the balance of agency between driver and means of transport in favour of the latter. The actant's perspective thus becomes more relevant, shifting the attention to algorithms and those who elaborate them.

Relational approaches can be declined in terms of reciprocity (Göbel et al. 2013). In that case, MLP appears even more distant, as one may wonder whether an actant – imagine not only a self-driving car, but also an automatic system for regulating a hydropower plant – may be able to use the register of reciprocity. Modern hydropower plants have a system for recharging the basin with the water below. The plant is regulated by the principle of best price/least cost of working, because of the mentioned introduction of an electric market. In theory, such a plant could be regulated by a mix of principles, including the need for water by downstream farmers, conservation of a minimum flow, and beauties of an artificial basin full of water. At this stage, a relevant question might be if and

how the software, managing the hydropower plant, will be able to also regulate relationships of reciprocity between different uses of water.

Looking at those objects through such a perspective introduces us to the third way social sciences and techno-sciences interact: that is, by locating the former below the latter. Basically, social scientists receive requests and instructions from engineers. To make some examples, managers of energy utilities often ask to survey their consumers or employers to determine the level of satisfaction with the services provided. Similarly, managers ask experts of communication to inform residents nearby a power plant or open a dialogue with them about forthcoming major investments for its enlargement; indeed, there is an extensive literature on methods of participation (Chilvers and Kearnes 2015).

On the other hand, behavioural sciences such as psychology provide the best example of the 'below' position, because they tend to accept without discussing the aim of the organisation that commissions a research (Kasperbauer 2017). The main example comes from the 'nudge' approach, in which a light system of incentives pushes people to adopt behaviours more coherent with the goals of saving energy and, consequently, money (Thaler and Sunstein 2014). Venier and Palmieri (2018), managers of an important Italian utility (Gruppo Hera), show in a very practical way the usefulness of the nudge approach. They have two premises:

   i. Pro environmental policies have to be plural, contemplating bonding rules, material incentives, and a wide range of measures based on moral suasion. Most nudge techniques fall within the last category;
   ii. It is easier and more convenient to change people's behaviours than machines. People are more flexible than industrial devices, which also have a high cost of initial investment. On the contrary, users can be 'convinced' with simple methods, changing the architecture of the system. Heating modularisation of spaces is a typical example: rather than changing all the heaters, it is easy to digitalise the system and make people aware of their levels of consumption.

The second premise by Venier and Palmieri (2018) shows an unexpected resistance to change by non-human actors. Mechanical devices built at a big scale and highly integrated show more resistance than modular settings made of small devices only partially connected. Smart grids in the energy sector imply the use of sophisticated software quite close to artificial intelligence. Thus, the crucial point is how modular units of energy production and consumption interact and whether they are considered as actants or socio-technical devices.

Before getting to a conclusion on this important aspect, we come back to the basic information provided by the nudge approach applied to energy saving. Venier and Palmieri (2018) confirm the approach of Thaler and Sunstein (2014): information supply on levels of consumptions above the average induces energy savings. People are more averse to losing money than being rewarded; thus, they are more committed towards en-

ergy saving than winning a prize as the best consumer. On the other hand, according to Venier and Palmieri (2018), this strategy is not exempted from unwanted outcomes; indeed, most virtuous consumers may tend to consume more, the so-called rebound effect (see Greening et al. 2000).

Hera managers, however, point out that psychological behaviourism works more for households than for firms. Indeed, material incentives for firms are still necessary for inducing energy saving. The reasons are again psychological but, in this case, they are internal to the organisation. First, factory managers are concentrated on the core business, which unlikely is energy saving for the sake of the environment; second, the savings achieved with energy saving measures are not necessarily included in a scheme for assessing managers' performance. As a result, it is likely that managers activate on energy only if they see great gain for company, such as major material incentives arriving from outside. Otherwise, they prefer to contract out any energy service, like saving interventions and maintenance of energy devices. In other words, managers are not motivated to compete with managers of other firms on the field of energy.

Behavioural psychology seems to work better for households than for factories. Thus, the 'below' position of social sciences needs both internal integration between different kinds of psychologies, and vertical integration with other approaches, at least history and sociology, placed in the 'above' and 'beside' positions. The architecture of energy saving needs – according to Hera managers' conclusion – extensive knowledge of each factory, its employers, and its physical structure for planning ad hoc interventions, discussed with all stakeholders. Otherwise, it is preferable to externalise the energy service, losing sovereignty and increasing transaction costs.

In conclusion, psychological mechanisms have their own strength, but they have to be supported by i) analyses of the socio-cultural context (e.g., in mainly Protestant countries the value of competition is more accepted, than in non-Protestant ones: see Hayward and Kemmelmeier 2007, p. 392); ii) understanding of the professional ethics of managers and employers, who can prefer the option 'to buy' the energy service than 'to make' it internally; and iii) the study of the geography of reference groups: near businesses rarely work as 'benchmarks' for readjusting a company behaviour. Finally, relational dynamics have to be considered, because the nudge approach is based on a cognitive comparison, not on material exchanges among actors. This last criticism introduces the attempt to make a combination of varied social science positions vis-à-vis the techno-sciences. This attempt relies on the study of social practices.

Social practices in Search of a Model

The social practice approach (SPA) has been extensively used in environmental and energy sociology (Bartiaux et al. 2014). The reason appears clear looking at the limits of behavioural approaches. SPA allows considering simultaneously agency, space, and time — in other terms, actions, environments, and durability. Because a large part of human activity is routine with little variation, it appeared clear that neither single acts nor contexts in isolation have to be studied but long sequences of situated interactions (Shove 2017). Thus, energy saving behaviour is neither a simple reaction to a stimulus (your neighbour is better than you) nor the result of just a reflection in the actor's mind, as some cognitive approaches affirm; nor, finally, the sediment of prolonged interactions, as social constructivists hold. It is a practice in which cultures, spaces, and habits co-exist, forming appropriate 'atmospheres' (Löw 2008).

Practices of energy saving thus become a sequence of small daily gestures, made up of control of the temperature in the room, calculated openness of windows, adequate clothing, and so on. They are effective as long as they are under the control of actors (agency) and affordable, without great investments in infrastructures. Moreover, the advantage of such an approach is it allows analysing ecological incoherence. Pro-environmental behaviours are often not integrated, determining a trade-off effect which undermines the final result: for instance, solar parks produce renewable energy but entail sterilisation of farmland (Sacchelli et al. 2016).

Despite being useful, SPT seems less effective when we move from micro-situations to important choices or management of big organisations. It is the same difficulty that the nudge approach has to face vis-à-vis factories and managers. The practices one is helpful for understanding routines but less for accounting for crucial choices, like building a house or buying a car. In the last cases, we need a model of society able to formalise and abstract from thousand variants of action + situations. Thus, practices become an empty box in search of a framework. Traditionally, sociology adopted Weber's notion of rationality, with variable adjustments (types of rationality); subsequently, another representation of humankind has been the dramaturgy of Goffman, which has enjoyed a vast success. The great success of political ecology is a further sign of this search for filling the box of energy studies with a model (Cherp et al. 2018).

In order to reduce the instrumental attitude of above approaches such as political ecology, the game-playing metaphor has been recently introduced in environmental studies (Osti 2018, 2019). It should help to diversify the range of key factors able to assemble and give coherence to pro-environmental practices. Thus, the practices approach is completed with a general interpretation of social reality (model). It is intriguing that the

idea of energy transition can be used for representing the entire evolution of society (Carrosio 2014; Gabrys 2014).

The idea of social practices in search of a model is arguably a first result of our analysis. However, even social models may be blamed to be too abstract and rigid for energy studies. A way to keep both models and their concrete application to the variety of energy practices is to reduce the scale of abstraction and to focus on middle-range processes.

Relevant middle-range socio-technical processes for energy issues can be:

    i.   monitoring
    ii.   sharing
    iii. playing

Monitoring. In the energy field, but common to all environmental issues, monitoring has a central role at the social level (Environment Management Group 2012). The success of or appeal to citizen science experiments (Wylie et al. 2014) reveals important things: there is great uncertainty on how complex systems work. Energy is one of these, even if more predictable and measurable than others. In fact, full automation of power plants or of home services does not solve the need for manual regulations. At the same time, diffuse generation and smart grids advance very slowly, because the interface with human agents is unpredictable and full of side effects. A way to circumvent this impasse, ostensibly, is monitoring. This should be done in terms of extensive and conscious participation, that is by establishing routines of self- or shared monitoring. On this point, there is major room for cooperation between social and techno-science practices.

Sharing. In the energy field, we noticed sharp differences in terms of the self-organisation of residential communities. In some European countries, energy communities have flourished; in Italy, they have flourished only in Alpine border areas. Evidently, cultural biases play a role since, for instance, other areas such as Central Europe generally have proven to be more innovative (Magnani and Osti 2016). Nevertheless, special and accidental combinations between social organisation and renewable energy packages have occurred. Both cultural determinism and technological determinism are to be abandoned. Case-by-case matching of community resources and energy packages has to be explored. Innovative models need to be identified, such as non-contiguous networks of citizens sharing green energy. For network configuration, different technological packages are necessary.

Playing. In the energy field, we have seen the desire for competition emerging as a leverage for inducing worthy behaviours. When experimental simulations are conducted, this emerges as a result, having thus an exemplary value. But we would be prone to believe that people participating in experiments contributing to calculate sets of statistics are not like Pavlov's dog, simply responding to a stimulus. *À la* Goffman (1961),

they can simulate, adapting to research expectations and playing the role of good test subjects. The role distance concept helps in this and in other cases to highlight the human capacity to play with others and with technological packages. We know role distance is relative and changing; sometimes the game itself takes the upper hand and everything becomes terribly confused for players themselves. Hence, a playing approach shows us the limited importance of experiments.

Conclusion

As a final remark, two further points can be highlighted: i) a plurality of positions and relationships among disciplines is beneficial to a better understanding of the energy issue; social sciences are not only ancillary to the 'hard' ones but can also tackle the root of the problems and help connecting complex systems. This has a symbolic and practical importance in projects concerning energy transition, which have often a multidisciplinary character. ii) There is a sort of circularity within social sciences: first, the relational perspective helps overcoming some limits of traditional holistic and atomistic approaches; then, practices theory adds to relations a spatial-temporal dimension; finally, and this closes the circle, practices need more general frames, an ideology or an anthropology, in order to cumulate knowledge, to compare different countries and to formulate previsions.

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Thinking about the Differing Contributions of (Social) Psychology and Sociology for Understanding Sociotechnical Transitions Perspectives on Energy Supply and Use

Paula Bögel, Paul Upham and Paula Castro

Introduction: Socio-technical Transitions, Sociology and (Social) Psychology

Sociotechnical transitions thinking attributes our unsustainable development trajectories to complex and enduring interconnections between scientific and technological development, industry, markets, policy and culture. All are said to co-evolve in a complex system of mutual and usually self-reinforcing processes (Kemp et al. 1998; Geels and Schot 2007). There is some explicit discussion of ontology in (for brevity) the 'transitions' literature on this complex process of co-evolution, but it is arguably fair to say that this has rarely been a primary concern. Geels (2010) is a notable exception, as the author discusses how the transitions literature draws on social theory with a variety of ontologies, very often only in a tacit way; and how MLP fits into this variety, given its heuristic, integrative nature. More often than not, though, authors positioning themselves within sociotechnical transitions frames are more concerned with specific conceptual, theoretical and/or empirical aspects of their cases, than with discussing underpinning assumptions about the nature of the social world. Moreover, while the literature recognizes the importance and roles of individual actors, the agency of those actors - their capacities to act and the influences on those capacities - have been scarcely theorized (Bögel

and Upham 2018). It would seem that relatively little has changed in this regard since Genus and Coles (2008, p. 1442) observed that individual actors are often critical to changes in the 'rules' that are assumed in structuration accounts to pattern society. Geels et al. (2016) is one of the exceptions and we return to this in the last section; another recent contribution is Wittmayer et al. (2017), regarding actor roles; similarly, Fischer and Newig (2016); none, though, are concerned with the subjective experience of actors and the relationship of this to transitions processes.

In this context, the goal of this paper is to show lines for further development – of how theoretical accounts from transition studies, sociology and (social) psychology could be used, particularly in an interdisciplinary way, to improve our understanding of the subjective experience of individual actors and actor groups as an essential driver or barrier for sustainability transitions. For this purpose, we first outline the different assumptions characterizing the ontologies of sociology and (social) psychology via-à-vis transition studies; these assumptions will be the basis to continue with the question of how to bridge those different approaches. The focus for this purpose is on (social) psychological approaches and their potential crossovers with sociology, particularly social practice theory (SPT) and transition frameworks, as the role of psychology for understanding agency, and here particularly the role of subjective experience, in transitions is our main concern in this Crossing Boundaries.

Sociology in the Sociotechnical Transitions Literature

Sociotechnical transition researchers do acknowledge the role of subjective human experience, but mainly from sociological perspectives, which underlie the social foundations of transition frameworks (e.g. MLP, see Geels 2002; or the Triple Embeddedness Framework, see Geels 2014). For prominent sociological accounts in transition studies see studies on the roles of meanings, interpretation, discourses and symbols (Stedman, 2016) in transitions, understood from social perspectives, and in particular studies on the role of social practices for transitions (Köhler et al. 2019). In social practice theory, "routine human action is understood as a product of collective social practices influenced as much by the environment as it is by personal preferences or processes of deliberation (Köhler et al. 2019, p. 729)". Practices are thus a key unit of analysis. With roots typically in Bourdieu's (1977) theory of society as structured and stratified in part by repeated and routinized practice, this work has examined a range of practices with environmental and energy consumption implications (Hand et al. 2005; Shove 2010a).

While sociological or cultural accounts of subjectively-experienced phenomena place their focus external to the individual in terms of processes, psychology emphasises individual-level characteristics and processes. These processes may have a social dimension (e.g. the influence of social norms), but whereas: "sociologists generally devote their efforts to

identifying *which* social phenomena have effects on individuals" … "psychologists generally specialize in *identifying the mechanisms or processes through which* social phenomena have their effect on individuals" (Thoits 1995, p. 1231).

Psychology in the Sociotechnical Transitions Literature

A recent literature review by Bögel and Upham (2018) shows the potential of (social) psychological approaches for improving our understanding of agency in transitions; but it also highlights the little use that sociotechnical transitions theory has made of psychology to date. The review shows that the primary use of psychology in this literature has been in relation to consumption and technology acceptance. Of the large variety of psychological perspectives and theories available, only six main theoretical perspectives have been deployed in the sociotechnical transitions literature, namely (i) rational and mindful decision making, with the Theory of Planned Behaviour (Ajzen 1991, 2011) being the most prominent approach and probably among the psychological theories most used in transition studies in general; (ii) habitualized behaviour, mainly studies from SPT perspectives and with new approaches emerging from identity theories; (iii) the role of norms, with e.g. norm-based approaches such as Stern's Value-Belief-Norm Theory (for an overview see Jackson 2005) being quite prominent in environmental psychology but rarely used in transition studies (with the Energy Cultures Framework by Stephenson et al. 2015 being an exception but quite differently premised); (iv) societal level theories, mainly represented by Social Representations Theory (SRT; Moscovici 2000); (v) place attachment, including place identity approaches; and (vi) information and persuasion approaches. Concerning social practice theory, it should be noted that while sociological in origin, as conceived by Bourdieu (1984) SPT has a social psychological component in terms of individuals' habitus and dispositions, offering cross-over potential between psychological and sociological perspectives.

Indeed, the meaning of the "social" in social psychology has developed over the years in two main directions, each producing a different view of what social psychology is and should be (Rijsman and Stroebe 1989; Rizzoli et al. 2018). In the first direction, the social is treated as an enveloping context and/or an applied topic, and the task of psycho-social research is to target universal individual-level processes: fundamental needs, core motivations, traits, and information processing capacities. These are seen as universal-individual-natural processes that often happen in social contexts and with social stimuli. An example of such a position is the suggestion that a "social" social psychology can be achieved by maintaining theorizations focused on the individual level, provided that group/societal processes are included in the research designs as pertaining to context (Taylor and Brown 1979). In other words, here the pro-

cesses to be studied are conceptualized at an individual level, whereas the topics analysed are social, and/or of social relevance (Rizzoli et al. 2018).

According to the second position, the social is neither an applied topic, nor an enveloping context (Batel et al. 2016; Batel and Castro 2018); the social is viewed as constitutive of the psychological, and the focus is on how meaning and action emerge from various (Subject-Other-Object) relations (Moscovici 1972). In this view, there is no stark distinction between the social and the individual (Greenwood 2014; Moscovici 1988; Reicher 2004): context and relations are not external/enveloping variables and for developing theories and research questions, social psychology needs to consider how social and historical facts constitute psychological subjects, relations and contexts (Gergen 1973). Many of the questions posed by this second direction are concerned with how psycho-social processes - such as social identification, communication, representation - are involved with how change and stability are both achieved and legitimated in societies (Castro and Mouro 2016). It is naturally the second line of research that lends itself more closely to integration with societal-level sociological and system-level transition studies frameworks.

Understandings of Agency and Action: Socio-Psychological Approaches and Their Implications for Energy Transitions

In this section, we consider two theoretical perspectives from the second line of social psychological research, namely SRT and identity approaches, for studying subjective aspects of agency in transitions. We do so on the premise that these perspectives: (i) offer particular insights into the behaviours and practices that structure societal relationships with technologies and systems of provision; and (ii) are amenable to a degree of integration or meaningful juxtaposition with the high-level process concepts of sociotechnical transitions thinking, to date focused more on collective than individual processes and experience. As empirical illustration of how the different perspectives complement each other (with connections to SPT), we take the case of energy supply and demand. While there are different policy implications deriving from the disciplinary ontologies (see e.g. Shove 2010b), analysts from different ontologies agree on the need for behaviour change as one characteristic of, or precondition for, a sustainable energy system. This agreement and the large variety of studies on this topic emerging from all these perspectives, including SPT, make energy supply and demand a suitable Boundary Object (Star and Griesemer 1989) to illustrate the theoretical perspectives, their differences but also possible points of connections.

Social representations theory (SRT)

SRT (Moscovici 1988) is a major social psychological theory about meaning-making and communication. It posits that social representations

have two functions. First, they conventionalise new concepts and give them a recognizable and common form, thus enhancing communication and coordination within a group: "These conventions enable us to know what stands for what" (Moscovici 2000, p. 22). Second, representations prescribe ways of thinking about topics: "they are forced upon us, transmitted, and are the product of a whole sequence of elaborations and of changes which occur in the course of time and are the achievement of successive generations" (Moscovici 2000, p. 24). Nevertheless, SRT also emphasizes how social representations change through interaction and communication, and as the social groups through which they travel change, also how new ideas, which in turn are anchored to older representations, constantly emerge from these processes and relations. In other words, SRT highlights how 'all encounters with the world are mediated through relationships' with other social beings (Castro and Batel 2008, p. 479) and hence how meanings are always relational and co-constructed (see Howarth 2006). This is often referred to as representations emerging from Ego-Alter relations, the site where meaning is not just constructed but also transformed. Moreover, SRT highlights also that these relations happen in a culture and are constrained by its institutions, and therefore that understanding meaning making requires taking into account the three dimensions of culture, context, and interaction, and acknowledging that these are not external variables (Batel et al. 2016; Castro 2015).

There is work drawing from SRT for examining energy representations and energy controversies. The approach has informed a theorization of local resistance to the construction of renewable energy infrastructures that views it as place-protective, arising from interpretations of the structures – through a community's shared representations and communications – as threats to place and to people-place relations (Devine-Wright 2009). Further, empirical analysis has shown how representations of the countryside or seaside are used by residents to make sense - and refuse – certain energy infrastructures (Devine-Wright and Howes 2010; Batel et al. 2015), or for demonstrating how the representations of energy in Italian political debates and newspaper articles bear witness to the prevalence of economic approaches and a view of citizens as needing to stay passive (Sarrica et al. 2014). Also, some work shows – through analyses of re-convened group sessions with citizens from two French communities where smart meters were first installed - how the shared elaboration in the groups led participants to consider more collectively-oriented approaches and goals to make sense of the meters (Bertoldo et al. 2015).

Identity theories

Two lines of identity-approaches will be considered here: (i) theoretical perspectives for the role of symbolic meaning for personal and social identity, offering crossovers to SRT and (ii) social identity theory. Regarding the first, namely meaning and identity, this perspective can be traced

at least to Mead (1956), who argued for a socially constructed nature of the self and the associated role of communication: "a self can arise only where there is a social process within which this self has its initiation. It [the sense of self] arises within this process" (Mead 1956, p. 42). This basic idea has continued through to contemporary accounts, in which material artefacts are assumed to have symbolic meaning derived through social negotiation and thence incorporated into a sense of self, with implications for behaviour, including consumptive behaviour (Jackson 2005) and energy demand. The meaning and the construction of meaning of these material goods is posited by Elliott and Wattanasuwan (1998) as shaped by three processes: lived experience, mediated experience and discursive elaboration. Lived experience relates to people's experience with artefacts, e.g. new energy technologies in their homes. Mediated experience relates to the presentation of symbolic resources in multiple forms of media, for example of different renewable energies. The process of discursive elaboration describes the negotiating of the symbolic meaning and the self with relevant others, e.g. friends, family and colleagues. Concerning the role of symbolic meaning and identity for energy demand and supply, Nye et al. (2010) suggest research focusing on social construction of identity and consumption may be a promising way to study habitualized behaviour; the basic assumption being that identity and lifestyle aspects are key drivers of energy behaviour. Nye et al. (2010) mention the example of air conditioning as a symbol of modern life. Likewise, lighting can be interpreted as a symbol for prosperity. While the authors focus in their suggestions on everyday energy demand, the role of symbolic meaning and identity might also be extended to acceptance studies, offering also potentials of crossovers between SRT and symbolic meaning and identity-approaches, discussed in more detail in the following section.

The second theoretical perspective, namely Social identity theories view identity as an interplay of societal and individual processes, despite being primarily social psychological in nature. An example is the approach of Schmid et al. (2011), which encompasses Social Identity Theory and Self-Categorization Theory, and assumes that individuals apply distinct social categories to understand their social world, such as gender or professional categories. These categorizations create in-groups and out-groups, which in turn influence individual (and group) attitudes and behaviours. In this respect, social identity theory has been described as being "at the heart of social psychological theories" (Schmid et al. 2011, p. 211) and is applicable to a wide range of social contexts and processes. Such contexts include institutions, organisations, firms, governments and consumers in aggregate or as sub-groups. With regard to energy demand and supply, individualistic psychological approaches have been in the focus of research but recently authors have started to study the role of social identity for both (i) household energy and (ii) the growth of community energy (or other social movements), addressing the changing role of

consumers (towards prosumers) in energy systems. Concerning (i), Mäkivierikko et al. (2019) build on both the Theory of Planned Behaviour and Social Identity (see also Fielding et al. 2008) and examine the influence of social identity among neighbours on energy demand reduction. Concerning (ii), previous studies have recently started to discuss the role of identity for the development of social movements in general – either as a driver or barrier for social diffusion – (Seyfang and Haxeltine 2012) - and community energy in particular (e.g. Pohlmann and Colell 2017).

Theoretical Crossovers between SRT, Identity Approaches and SPT

In the following, we discuss possibilities for theoretical crossovers between SRT and identity theories as well as their potential cross-overs with SPT, with a separate discourse on the social psychological elements of SPT *per se*; the overall purpose is a richer understanding and theorisation of actor-level experience in sociotechnical transitions processes. We start with discussing potential crossovers between the social psychological accounts presented here, namely SRT and identity-approaches. There are clearly many points of connection between the psychosocial approaches considered here. At the core of these connections is the construction of meaning, or sense-making, which has implications for identity and action, practice or behaviour. In the previous section, we already mentioned the possible extension of approaches on the symbolic meaning and identity to acceptance studies and the potential that this offers for crossovers with SRT. In fact, Elliott and Wattanasuwan (1998) some 20 years ago suggested to study the connections between the concept of social representations and their theoretical model on the construction of meaning and identity with regard to social-symbolism: "The concept of Social Representations could also be adopted to explore the socially shared meanings of consumption." Likewise, Castro (2003), citing Parker (1998) identifies points of connection between the two approaches: "the social psychological theory of social representations was part of a sustained attempt by the discipline to develop fully social explanations of identity and shared knowledge." This line of research could examine the role of social representation in relation to identity-processes, in turn with implications for further development of social representations, e.g. taking into account the findings on the role of social identities for joining community energy initiatives, or for the study of groups with contrasting social representations as often found in energy controversies. Such a line of research would take into account the ways in which action is shaped by in-group and out-group formation, in which social representations of all types of phenomena play a role. Vis-à-vis SPT, this would offer the possibility of studying individuals as agents of transitions rather than as passive objects; which

would be a key step forward given that a key critique to SPT approaches is the rather passive role that SPT ascribes to individuals in transitions. Further cross-overs between SRT and SPT in particular (see also Batel and Castro 2016) could start at the obvious insight that we inhabit a material world as well as an ideational one. Materiality and embodiment are where SPT can complement SRT, to more fully conceptualise and examine the roles of technologies, infrastructures and also biophysical systems involving non-human actors (Batel et al. 2016). In turn, SRT can add to SPT in at least two ways. First, by conceptualizing people as agentive in bringing about social change, and second by offering an account of the role of Self-Other and power relations in allowing, constraining, and/or enabling (Batel et al. 2016). In addition, SRT helps to understand specifically how new scientific knowledge is appropriated and becomes used as common sense in everyday lives. As such, it helps examine cultural and techno-scientific change and how this is appropriated in contemporary heterogeneous public spheres (Batel et al. 2016). Overall, SRT and identity-approaches may complement SPT by adding psychological dimensions without being overly-individualistic in the resulting account.

Conclusions and Further Research

Going forward, the previous section has set out general and specific options for further research on subjective experience in relation to sociotechnical transitions processes. A more extended range of suggestions as regards social psychological perspectives and also research design for multi-level work is given in Upham et al. (2019). We are only just at the beginning of the process of making further, close connections, arguably in part because disciplinary affiliations have hindered interest in making such connections (Bögel and Upham 2018). Cases of sociotechnical change are so complex and multi-layered that it is unlikely that we can neatly map a differentiated correspondence or suitability of different social psychological (or more broadly, psychosocial) theories, perspectives and empiric research for connection to core sociotechnical concepts and processes features - as, for example, represented in the MLP framework (Geels 2002), or in idealised typologies of sociotechnical change (Geels and Schot 2007; Geels et al. 2016). Rather, it is more plausible that psychosocial perspectives can be applied on a case by case basis, while considering the possibilities for generalisation, to help give a fuller account of the processes involved.

This will be facilitated where agents are not only acknowledged as important but are given a more central role. The local enactment approach of Geels et al. (2016) is one such starting point, as is earlier work to which the authors refer (Geels 2004; Geels and Schot 2010). All of the latter emphasise the roles of individual actors and social groups in competing and collaborating to shape relevant social rules and institutions. While

Geels and Schot (2010) refer to the option of analysing at different levels of 'granularity' (resolution or scale), they take the view that case-specific scale analysis may be less useful for the conceptualisation of transition pathways, which aggregate over time. We acknowledge that theoretical or conceptual connections between processes at very different scales are inevitably indirect, highly mediated and moderated as well as probably difficult to be definitive about tracing causal processes. Adding a psychosocial layer of analysis adds to the challenge. Yet these issues are inherent to multi-level analysis. Moreover, psychosocial processes are generally not stochastic: people are for the most part consistent and rule-following, seeking stability. These processes should be amenable to conceptual and theoretical connection to other conceptions and theories of sociotechnical change at different scales. What is at issue is the degree of conceptual or theoretical integration that is possible, and this is largely a function of the ontologies underlying particular concepts - hence our starting point. We hope that this short paper encourages further work along these lines.

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[1] For a review of the different approaches to SPT and its theoretical development, see Postill (2010). There is a very active community of scholars dealing with the study of practices through a wide array of methodological approaches. As Hui and Schäfer declare in the blog PracticeTheoryMethodologies, there is no unique perspective on the study of social practices, but rather "diverse approaches and conceptual vocabularies within the broad 'family' of theories, in contrast to individualist or normativist positions" (https://practicetheorymethodologies.word press.com/about/ retrieved on October 17, 2019). For this reason, it may be more appropriate to talk of "theories", rather than "theory".

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