Humans and stuff: Interweaving social and physical science in energy policy research

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Abstract

This short communication reflects on three main issues in light of Adam Cooper's paper: the logic of the relationship between physical and social sciences; the place of Schatzkian practice theory (SPT) in this in regard to energy research; and historical contingencies that bring different challenges to well-worked out theories in different epochs. The basic subject matter of physical science is inanimate materiality that is blindly subject to chains of causality that are predictable, at least in principle, whereas humans are conscious agents who can initiate causality unpredictably. Nevertheless, studies of human action can give somewhat orderly results through the use of either statistics or heuristics. SPT enables us to produce useful heuristics that link different domains of reality, and this can enable parameters of physics to be quantified in novel ways and settings. But no matter how neat our theoretical rigor, we need to adapt our approaches to address the historical contingencies that press on people's lives – such as today's enormous and rapidly growing disparity between the richest 1% and the rest of us. Having said all this, there is an important place for non-quantitative insights into humanity's journey towards a better life for all. We especially need to be careful to avoid quantitative tools of physics being used by elites to gain hegemony and power.

Keywords:

Physics in social science; Practice theory; realism; heuristics; historical contingency

1. Introduction

Adam Cooper's paper (this issue) raises stimulating and important questions regarding possible policy impacts of social science energy consumption research. His main thesis is that a lack of engagement with physics and its measurement units in much of this work, particularly as published in *Energy Research & Social Science* (ERSS), reduces or nullifies its traction among policy makers.

I want to take this further and relate it to three quite basic issues: the logic of science, be it of the social or physical type; some implications for the type of practice theory that originates from Schatzki, commonly used in energy consumption studies; and historical contingencies that affect what is fashionable and what works in the present epoch.

My own academic and vocational background is interdisciplinary, with professional qualifications and work experience in electrical engineering, social psychology, theology (including pastoral work), mathematics teaching and policy studies, and I now work in an economics faculty in Germany and an architecture faculty in the UK. For some years there were constantly three different discussions going on in my head: how the physics worked, including diverse arrays of units and numbers; what people were up to and why; and what life and the universe are really for. These began to come together in a reasonably coherent and rational way for the first time in my work as a church-appointed anti-nuclear activist in New Zealand in the 1980s. In one and the same public lecture I found myself explaining the numbers of what nukes can do to cities and ecospheres; addressing human issues of complacency, denial and potential for effective political engagement; and reflecting on philosophical issues such as what the destruction of humanity might mean. It is interesting that all the main political parties accepted the movement's precise legislative demands, and I think it was because the movement won the arguments on all three levels in the New Zealand context (Salzman, 1987; Thakur, 1985).

My work of the past decade has been mostly in energy consumption, embracing technology, consumer behavior and policymaker behavior, together with underlying theoretical issues that impinge on these. The same three types of discussion go on in the same head: material stuff; people; and issues of logic, truth, falsity and meaning – commonly given the grand title 'philosophy'. This three-way discussion informs most of what follows.

Section 2 of this paper discusses some basic issues in the logic of science, in an attempt to explain how it is possible to hold the 'stuff' of physics together with the personhood of human beings. Section 3 reflects on Schatzkian practice theory (Galvin and Sunikka-Blank, 2015; Galvin and Gubernat, 2016) as one response to this type of issue, and some avenues in which practice theory could well develop. Section 4 attempts to put these issues into an historical context, suggesting that acting in accordance with a tidy, interdisciplinary, philosophically rigorous framework is not enough in itself to get traction on policy, since policy making happens within specific historical epochs. Section 5 concludes and discusses possible implications for ERSS.

2. Physics and personhood

Since clever human persons and dumb physical, material things exist in the same universe, it might seem at first that similar rules should apply to both, so that some kind of grand unified theory would cover everything and form a basis for interdisciplinary science. But while both types of being have material features (humans have arms, legs and neurons; even non-material physical things like gravitational fields issue from material objects) there is actually a profound mystery at the heart of what makes them different. This is commonly termed the 'hard problem of consciousness' (Chalmers, 1995; 1996; 1997) – 'hard' because consciousness appears to be inexplicable if the universe is just made of physical stuff. People are *aware* of what is going on around them and can reflect on it with a fair degree of freedom, while material things like mountains and even smart heating systems cannot do this (for reasons of space I am leaving non-human creatures out of the discussion, and also leaving aside the rich debate on different attempts to solve or explain away the 'hard' problem).

This has implications in many directions. For practical research purposes and ultimately for energy policy making it is helpful to distinguish how *causality* happens in each of these two domains. Social theory has a long history of seeking to identify what causes people to behave as they do (Baert and da Silva, 2010). Clearly there are many different kinds of constraint on human action and freedom, such as entrenched social practices (Shove, 2008); a person's socio-technical environment (Lovell, 2007); inter-subjective norms, values and 'rules' coming from societal discourse (Giddens, 1984; Ajzen, 1991; Bhaskar, 1986); and the individual's own ingrained habits (Verplanken and Wood, 2006). Despite all these pressures and influences, what makes us human is that we are not just nodes in a chain of cause-and-effect, but are agents – beings who can *originate* a chain of causality, i.e. act and behave in ways that bear no relation to antecedent causes, while material things can only do what antecedent causes make them do. Harre (2009), a philosopher of science who has made major contributions in fields as diverse as chemistry and psychology, sets this out systematically in his critique of critical realism (as proposed by Bhaskar, 1985; 2014). Harré argues that causality in human personhood is fundamentally different from how it is in inanimate materiality. Materiality always behaves in accordance with antecedent causes – everything that happens does so because *it was made to happen by some other physical event*. A water droplet falls from the sky because gravity pulled it down. Its molecules formed from water vapor because changes in pressure and temperature acted on them, and so on back up the chain of physical causality. However, Mary drank the wine only because *she freely decided to do so*. She might just as well have poured it into the stir-fry, stored it in the fridge, or tipped it down the sink. Nothing actually *caused* her to act the way she did.

The implications for the two kinds of science are profound. With physics it is possible to say precisely how much of one kind of phenomenon (e.g. CO2 emissions released) will occur if certain amounts of other physical phenomena occur (quantities of a particular grade of oil burnt, units of concrete made, etc.). But it is not possible to say with any precision how much CO_2 Mary's actions will produce, because Mary herself may decide to act in many different ways. This is the case regardless of what social practices Mary is engaged in, what her values and attitudes are, what cultural discourses she regularly parrots, what socio-technical environment she lives and moves in, and what her deeply ingrained personal habits are. There will always be inherent uncertainties built in to any kind of social science because Mary is a person, not a thing.

All is not lost for number-crunchers, however. Two useful approximate tools for social scientists are statistics and heuristics.

With statistics, we observe (large) numbers of Mary-like creatures and make judgements based on their past behaviors in relevant contexts, using carefully designed mathematical tools. With appropriate sample sizes, selected according to strict random probability theory, we can offer something close to 'predictions', and thereby recommend interventions to move people like Mary in directions desired by policy. Policymakers tend to like statistics, even about unpredictable creatures like Marys, because statistics have an air of 'hard' science about them. However, reading large numbers of such studies leads to the disappointment that very few select their samples according to strict random probability theory, so their p-values and statements of significance are often highly questionable. The American Statistics Association also complains that very few engage with the ubiquitous problem of what level of 'significance' is significant for whom, even if the numbers are right (Wasserstein and Lazar, 2016). In other words, social science papers using statistics need to move beyond the practice of simply stating something is significant because its p-value was 0.05 or less.

Nevertheless, in the end policymakers might find it quite helpful to hear that (for example), if people keep behaving as they have over the last 5 years, every 1% increase in energy efficiency of domestic heating systems is 'highly likely' (i.e. with 95% confidence) to produce only 2/3 the reduction in CO_2 emissions predicted by engineering calculations (a 33% 'rebound effect' – see Galvin, 2015), because people tend to change their comfort preferences in reasonably predictable ways (on average) when efficiency increases lead to cheaper heating. A shortfall of 33% is large enough to warrant action even if it is highly approximate, unlike the finer differences in recent elections that have bedeviled pollsters.

Another approach within the broad spectrum of the sciences is heuristics. Harré (2009) and Harré and Madden (1975) argue that most science proceeds by the use of models. A scientist constructs a model in her head of what is going on, then tests the model by experiment or uses it on data collected in situ. While all such scientific models are inventions in researchers' heads, it is possible to distinguish two distinct kinds: models that are intended to *represent* what is actually there, in or influencing the objects being tested or investigated ('representational' models); and models that are an attempt by the researcher to construct an orderly mental framework for thinking more clearly about data which is by its very nature too diverse and/or chaotic to behave with clearly identifiable lines of causality ('heuristic' models). The physical sciences use both kinds of models, but mostly the representational type. If, for example, a new insulation material is conceived, a scientist might theorize that particular features of its molecular structure would cause heat to conduct through it at a certain rate. The model is a picture of tiny balls vibrating against each other, and calculations of heat transfer may be done on that basis. When the material is finally made, the model can be tested with real heat and measurement. If the measurements diverge too far from the predictions, the reviewers of the paper might suggest the scientist revisit his original model and modify it. Such models can be shown to be (more or less) correct or incorrect, because they are attempts to describe the physical world. By contrast, heuristic models are not attempts to describe the way the world *is*, but to think straight about data and information which is far from straight.

Practice theory is a nice example of a heuristic, as I suggest in the following section.

3. Practice theory

The term 'practice theory' refers to a cluster of social science approaches that focus on what people *do* rather than on mental processes that are assumed to go on in their heads. Practice theories arose in the wake of Wittgensteinian critiques of inter-subjectivist, rule-based social theorizing of the later 20^{th} century, such as in Giddens (1984). I would identify at least four different streams of practice theory: critical realism (Bhaskar, 1986); scientific realism (Harré and Gillett, 1995); morphogenic realism (Archer, 2000); and Schatzkian practice theory (Schatzki, 1997; 2002). Elements of practice theory were already emergent in Giddens (1984) and Bourdieu (1976), but later theorists saw these as hobbled by a lingering over-commitment to inter-subjectivist philosophy (see discussion in Galvin and Sunikka-Blank, 2016). Since almost all practice theory approaches in energy consumption studies are rooted in Schatzki's version of practice theory, it is this version I will discuss here.

At the risk of over-generalizing, Schatzkian practice theory (SPT) is deeply interested in routinized actions that are purveyed, executed and reproduced in social contexts. In Reckwitz's (2002a; 2002b; 2012) interpretation of Schatzki, practices (such as the practice of smoking) happen at a convergence of *material elements*, such as cigarettes and doorways; *routinized bodily actions* such as inhaling and exhaling smoke while holding the cigarette in the locally culturally accepted manner; and elements of *meaning and affect* such as acting cool and feeling calmed down. Although many people smoke alone, smoking is a *social* practice in that its rituals, skills, supply chains and associated meanings exist and are reproduced within a more or less identifiable community or quasi-community.

The bringing together of material stuff, bodily actions and meaning/affect within a social context, as explicated in Reckwitz (2002a; 2002b; 2012), has made practice theory an interesting approach for energy consumption studies, since regular energy consumption tends to include all these elements. Further, Schatzki's later development of practice theory joined it up with a theory of material structures and infrastructures (Schatzki, 2010), which he calls "arrangements", and these are also heavily implicated in energy supply and consumption, a theme further explored by Shove and Walker (2014) and tested in an empirical setting by Galvin and Gubernat (2016).

Since SPT is deeply interested in materiality, it is somewhat surprising, as Cooper points out, that it seldom produces figures for consumption, insulation, emission production, etc., in the units of the physical sciences. This, he points out, makes it less interesting to policymakers, who have to estimate clearly how much net benefit there will be from proposed interventions.

One of the basic reasons for this probably lies in the very nature of SPT. A 'practice' of the SPT type is a heuristic, a model in the mind of a researcher. While we can count and agree on the number of smokers and lung cancer sufferers, 'the practice of smoking' is a much vaguer notion and there can be countless versions of what this 'practice' actually is and what its props and boundaries are. The same goes for practices of shopping, cooking, holidaying, journeying, computing, etc. Defining a socially formed thing as a 'practice' enables a researcher to make useful connections between its constituent parts, but at the cost of loss of universal veracity. Look at the practice of policing in Chicago from the standpoint of the police chief and you might get a totally different picture of what this practice consists of, from looking at it from the perspective of an African-American community leader. In Germany the practice of insulating single family homes appears to be construed very differently among policymakers, from how it is construed among certain groups of home owners, and differently again among maintenance managers of housing providers (Galvin, 2012).

This can put practice theorists on the back foot, because one person's definition of a specific practice may be quite different from another's. However, it need not weaken SPT's usefulness for policymakers and the researchers and analysts who inform the policymaking community, as well as for research funders and relevant social action groups, because the heuristic of a practice brings together different domains, some of which can then be readily quantified in physical units. For example, in a study of ventilation practices in homes in Aachen, Germany, using the SPT version explicated by Reckwitz (2002a; 2012), I suggested there was a mismatch between the 'practices' of manual ventilation, pot-plant keeping (especially on window sills) and window manufacture (German windows open inwards and knock the pot-plants off when you try to ventilate in the government-recommended energy efficient manner) (Galvin, 2013). I suggested these three ‘practices’ were simply heuristics, e.g. I would not begin to claim my description of ‘pot plant keeping’ was *the* correct one or even a universal one, but rather a useful one for linking various factors together in one’s head, as these factors did seem to interact with each other. I then linked this framework together with a large-scale statistical analysis of window openings and pot-plant window-opening encumbrances throughout the Aachen municipality, and a thermodynamic analysis of energy losses through different types of window opening. The result was the suggestion that about 30 times as much energy is wasted in home ventilation in winter in Aachen as is necessary (nicely tabled in the units of physics), because of the mismatch of these three practices. This led to specific recommendations for policy regarding window design and for changes in household informational literature regularly distributed by the Federal Environment Agency (*Umweltbundesamt*). Hence the use of an SPT heuristic enabled linkages to be made between statistical findings, thermodynamic calculations, and human actions that tend to join these up.

Interestingly, none of the reviewers of the paper, published in Energy and Buildings, objected to the use of SPT to join up sections of research grounded in the hard sciences and quantifying results in the units of physics. Not so with a paper quantifying rebound effects and energy consumption in ICT and based around practice theory, submitted to ERSS (Galvin and Gubernat, 2016a), where at least one reviewer objected to our quantification of megabytes, energy consumption, etc. because practice theory ‘prefers’ qualitative data, not quantitative.

So I see no reason why SPT cannot be used in conjunction with precise measurements of the units of physics. The important thing is to keep the distinction clear between the two types of models being used in the same study: heuristic, and representational.

4. Historical contingencies

Although there can be clean, universal-sounding arguments for the usefulness of various kinds of social-physical science entwinement, as tentatively outlined above, the policy context is subject to many kinds of historical contingency. This can make different social science approaches more prevalent or more relevant at different times, for reasons that may have little or nothing to do with their internal coherence or explanatory power.

Regarding prevalence, it is a historical contingency that inter-subjectivist, mentalist, values-based social science approaches, in particular the theory of planned behavior (Ajzen, 1991) arrived on the scene and became established in energy consumption research before theories that treated material stuff more centrally (Madlener and Marmse-van Hout, 2011), such as socio-technical theories (Lovell, 2007), actor-network theory (Latour, 1993) and SPT (Shove, 2008; Warde, 2005). More recently, theories of habitual behavior are starting to be used in energy consumption studies (Kurz et al., 2015; Verplanken, and Wood, 2006). Like SPT, these are highly compatible with aspects of Bourdieu’s notion of habitus. A key feature of habitus is the insight that much of people’s routinized behavior is enabled by skills and auto-responses that have become incarnate in their mind-body (e.g. in playing the guitar one’s fingers do the delicate work automatically, freeing one’s mind to think about which chord sequence to move to next), rather than by mental assent to sets of discursive rules (Schatzki, 1997). But while SPT emphasizes the *social* focus of such routines, the theory of habitual behavior explores how they function in the *individuals* who perform them (Kurz et al., 2015). It also uses quite robust metrics for estimating habit strength and frequency of performance. In principle this is compatible with mapping physics-based metrics and can slot in neatly with it. If James performs his habit of leaving the lights on when he goes out 78% of the time and his average outing takes 5 hours, one can calculate the amount of energy this will waste. If SPT-theorists were to forge clear, logical links between social practices and their concomitant habit performances by individuals, this could provide a useful quantitative extension to SPT. It depends, however, on whether historical contingencies, such as in research funding and fashion, will enable theories of habitual behavior to take a stronger hold in the energy research community.

A second kind of historical contingency is socioeconomic. SPT tends not to engage much with the socioeconomic standing of its research subjects (Galvin and Sunikka-Blank, 2016). This tendency appears to be rooted in Schatzki's bracketing out of the very prevalent socioeconomic elements in Bourdieu's notion of habitus, while he used other aspects of Bourdieu's schema as a platform on which to develop his version of practice theory (Schatzki, 1997). This is a serious shortcoming, especially in the present historical epoch. A theme now widely discussed in economics literature is the rapidly increasing disparity of wealth and income between the richest 1% and the poorest 90% (most of us!) in OECD countries, since the shift to neo-liberal economic policy in the 1980s (Acemoglu et al., 2008; Osberg, 2013; 2014; Stiglitz, 2013; Veall, 2012). Most people are significantly poorer today in real terms than their equivalent cohort several decades ago, especially when accommodation costs are included in the reckoning. In job-rich cities in the UK, New Zealand and Canada the ratio of median house price to median income has risen, over the past 30 years, from around 3.5 to around 10, with some cities pushing 20 or higher (Schembri, 2015; Spencer, 2015). This makes it almost impossible for young people to buy homes to live in (Clarke et al., 2016). Home ownership rates are falling in all these countries, especially among under-40-year-olds, and also in the US and much of Western Europe, where homes are bought up increasingly by wealthy international and local elites, often as 'safe deposit boxes' for their enormous excess wealth (Fernandez et al., 2016; Fernandez and Aalbers, 2016)

This could be seen as representing the emergence of a new socioeconomic epoch (cf. Stiglitz, 2013) and it has huge implications for energy consumption behavior. Firstly, the 'landlord-tenant dilemma' (Ástmarsson et al., 2014; Bird and Hernández, 2012) would suggest that fewer homes are thermally retrofitted if fewer homes are owner-occupied. Secondly, enormous quantities of embedded CO2 are caused by the 'buy to leave' practices of international wealth elites, who buy up prime properties and leave them empty or visit them just occasionally (Fernandez, 2016). A third consequence not yet explored is a possible loss of trust and confidence in government and the economic system, among those who increasingly feel dispossessed. The recent US general election result, the Brexit vote and the rise of the far right in EU countries appear to be largely a consequence of an increasing sense of alienation from the promised benefits of a free democratic society. What implications might this have for people's willingness to accept discomforts in order to help government achieve its energy and climate goals? How is it affected by the common knowledge that huge quantities of CO2 emissions are caused by wealthy firms that have cleverly made themselves largely immune from significant regulatory control and taxation?

I would suggest two of the most important types of discussion in social theory are: (a) the form of social theories, including philosophical critique of their assumptions, internal logic, etc.; and (b) empirically based analysis of the current characteristics of society – its wealth distribution, its health, its politics, its myths, etc. – what kind of epoch do we live in? The second of these needs to be more present in discussion of energy consumption. It seems to me that this is an urgent need, if we want to save the house rather than just odd bits of furniture.

5. Conclusions

This brief paper reflected on Cooper's assertion that lack of quantitative physics in social science papers on energy consumption seriously reduces or nullifies their traction among policymakers. The paper explored three main areas in relation to this.

Firstly, it asked what distinguishes social and physical sciences. At their root, the two are demarcated by the consciousness and agency of human beings compared to the lack of these in non-animate physical things. Therefore causality runs relatively simply from physical thing to physical thing, whereas humans can initiate chains of causality without antecedent cause. This makes neat analysis of social things inherently imprecise, though if numbers are needed, statistical studies carefully applied can often give credible if approximate quantitative results that then lend themselves to translation into the units of physics. So, in this way, scientifically grounded or physically measured social science may be necessary for policy impact, but it is not sufficient. Social science can also exploit the power of heuristics to construe connectivities between different fields, some in which people play a major role and some in which only the rules of physics apply. The important thing is to keep a clear account of which models are heuristic and which are representational.

Secondly, the paper discussed what this might imply for Schatzkian practice theory (SPT). It argued that practices as conceived by SPT researchers are heuristics, and gave an example of how this can join together human and non-human features within an energy consumption issue, producing both statistical and thermodynamic quantitative results that might be of use to policymakers. This can exploit SPT's concern with material things as part and parcel of the bundles of interacting fields that make up a practice. Of course, the research team needs to include the necessary skills and competencies for both types of science.

Thirdly, the paper suggested that historical contingency plays a key role in determining what social science approaches are currently popular, and also in determining the socioeconomic characteristics of energy consumers. It called for social science energy consumption studies to pay more attention to the massive and rapidly increasing disparity between the wealth, income and influence of the richest 1% and the falling standard of living of most of the rest of humanity in OECD countries (not to mention less fortunate lands). SPT has untapped potential in this regard, if it can revisit the socioeconomic dimensions in its Bourdieusian roots.

Having made these remarks, I would, however, take issue with Cooper's suggestion that the proportion of papers containing physics metrics should be about as high in ERSS as in Energy Policy. Despite being an electrical engineer and enjoying writing papers and books that ooze with such units, I offer a paper here that frequently mentions physics but avoids explicit use of these units. Will this paper therefore be of no interest to policymakers? Perhaps not. Will it engage with other social scientists in thinking about the place of hard quantitative data for policy makers? Hopefully so. ERSS has a very special place as a forum where pressing issues of energy and social science can be discussed. There is a need everywhere for more researchers who are thoroughly interdisciplinary, and if we can guide policymakers more effectively by giving them more numbers, well and good. But please leave plenty of space for those of us who feel we (also) have contributions to make in other ways and sometimes like to leave the formulas and number crunching aside.

There may also be a kind of elitism in being competent with numbers and units of physics which does not sit well with an inclusive society of citizen-consumers. When I worked as a mathematics teacher about half the people I met at parties said, as soon as they found out my profession, 'I'm useless at maths' (or stronger words to that effect). Many such people make huge contributions in other areas. Some are academics who inspire, guide and admonish us in fields such as history, music, geography, psychology and political studies. Others do essential jobs like cleaning our suits, minding our children or sharing the wisdom of their old age with us. All need to keep warm in winter and pay their fuel bills. All have a legitimate stake in the way quantities of energy are apportioned, taxed and costed. All must have a say in the discussion of the future of the world including especially its climate and capacity to provide for human needs. We need to be careful not to let tools of mathematics and conceptual physics be used as tools of hegemony and power.

There I go again, getting all philosophical! But isn't that at least as important as being able to crunch the numbers?

(4562 words)

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