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Understanding the diffusion of Sustainable Product-Service Systems: Insights from the sociology of consumption and practice theory

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ABSTRACT

The sustainable product-service system (SPSS) concept highlights that achieving sustainability requires changes in both 'production' and 'consumption'. Nevertheless, attention has focused mainly on 'production'. This paper enriches the SPSS approach with insights from the sociology of consumption and practice theory to provide a deeper understanding of the use of products and services in daily life contexts. The paper advances three key insights related to: a) the internal dynamics of user practices, b) the strength of linkages of practice elements (loose and tight coupling), c) external linkages to other practices. These insights are mobilised to provide a deeper understanding of the uptake and diffusion of innovations such as SPSS. The insights are illustrated with two cases in which interventions designed to stimulate diffusion have had differential success: energy efficient light bulbs and low temperature laundry. Implications for understanding the diffusion of SPSS are discussed.

1. Introduction: Sustainable Product-Service Systems and consumption

The literature on Sustainable Product-Service Systems (SPSS) considers alternative social, technical and economic arrangements to meeting existing needs. Mont (2002: 239) defines SPSS as "a system of products, services, supporting networks and infrastructure designed to be competitive, satisfy customer needs and have lower environmental impact than traditional business models". While there are many small-scale examples of SPSS implementation (Ceschin, 2013; UNEP, 2002), there are few large-scale examples in which SPSS have replaced existing modes of consumer-need delivery. Arguably, the contribution of SPSSs to societal sustainability relies on their widespread diffusion and the replacement of existing modes of provision. It is therefore important to improve the understanding of processes which influence the diffusion and uptake of SPSS, which is the topic of the special issue of which this paper is part.

One of the strengths of SPSS is that the concept spans 'production and consumption' or 'product and use/service'. Nevertheless, it is fair to say that research has paid most attention to issues of design and management of systems (e.g. Morelli, 2006; Mont, 2002; Tukker, 2004). In a recent contribution, Ceschin (2013) uses insights from literature on transitions management to address possible ways of stimulating the diffusion of SPSS. While this contribution is useful, the conclusions focus mainly on firms and how they should re-orient their management strategies to facilitate more successful implementation of SPSS. So, despite its symmetrical focus on 'production and consumption', it seems that the consumption side of SPSS is under-developed. In a review of the SPSS field, Tukker and Tischner (2006) also conclude that attention to the dynamics of consumption within the SPSS research community has been lacking. This paper aims to address this problem.

The general contribution is to enrich the SPSS literature with insights from the sociology of consumption and 'practice theory' (see also McMeekin and Southerton, 2012). The specific contribution is to deepen the understanding of consumption dynamics and consumer responses to alternative ways of meeting their needs, and how these influence uptake and diffusion processes. While existing studies of diffusion and uptake tend to focus on the *acquisition* of products (purchase), practice theories suggest that *appropriation* (the use of goods and services in order to accomplish personal and social practices) and *appreciation* (the symbolic, communicative and aesthetic aspects of consuming) are also important processes (Warde, 2010). Practice theories thus offer the promise of a richer understanding of consumers and consumption, which goes beyond the economic (consumers as buyers) and socio-psychological

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(consumers have attitudes that drive behaviour) views (Shove, 2010), by also accommodating practical and cultural aspects of use.

The paper is structured as follows. Section 2 provides an introductory discussion of practice theory, which is one of the salient theories in the sociology of consumption. I identify three crucial insights to deepen the understanding of uptake and diffusion. First, consumer practices have their own endogenous dynamics, which shape the uptake of new products and technologies. Second, building on the idea that practices consist of clusters of elements (e.g. material, skills, meaning), I distinguish between tight and loose linkages, and discuss the implications of this. Third, the degree to which practice elements can be changed (e.g. via the uptake of new products) is shaped by external linkages with other practices, which may stabilise the focal practice. The relevance of these insights is illustrated with an application to two case studies: energy-efficient lighting and low temperature laundry in the United Kingdom. The first case is an example of relatively fast diffusion and uptake, while the second case is progressing more slowly. Section 3 presents the arguments for this case-selection and data sources. Section 4 applies the three insights to provide a deeper consumer-oriented explanation of the difference between the two case studies. A drawback of the two cases is that they are not directly about SPSS. Section 5 therefore not only provides general conclusions, but also explicitly discusses the relevance of the three insights for SPSS.

2. A social practices approach to understanding consumption

In the last decade, practice theory has emerged as a new approach in the sociology of consumption (Schatzki, 1996; Reckwitz, 2002; Shove, 2003; Warde, 2005; Røpke, 2009; Shove et al., 2012; Southerton et al., 2012; Spurling and McMeekin, 2014). Although there is disagreement between practice scholars, they share a focus on people as 'practitioners' (who engage in practices during the course of everyday life) rather than as 'consumers'. The basic idea is that people use (or 'consume') many resources and products while they engage in routine activities. For example, people 'consume' water, shampoo and energy (to heat the water) while they engage in the practice of showering. Similarly, people 'consume' energy when they turn on the light or relax through watching television. Whereas many economic theories of consumption focus on deliberate, conscious and rational considerations in purchase decisions (e.g. cost/benefit calculation), practice theorists focus on consumption that is less conscious, and shaped by habits and routines.[1] Warde (2005: 150), for instance, argues that: "People mostly consume without registering or reflecting on what they are doing because they are, from their point of view, actually doing things like driving, eating, or playing. They only rarely understand their behaviour as 'consuming'". This difference in conceptualisation is not only related to different disciplinary backgrounds, but also to a different substantive orientation. Practice theorists tend to focus on *mundane* kinds of 'consumption' (e.g. water and energy while showering, orange juice and bread for breakfast) whereas economic theories focus more on highly visible and expensive items (e.g. buying a house or car). A related difference is that practice theorists focus more on people in their daily life (in the home or at work), whereas economic theories focus more on shoppers in the high street. I would like to suggest that the practice focus on concrete user contexts is highly relevant for the SPSS-field, which also focuses on concrete innovations and use rather than abstract economic models.

Schatzki (1996: 89) delineates practices as "a temporally unfolding and spatially dispersed nexus of doings and sayings. Examples are cooking practices, voting practices, industrial practices, recreational practices". While this is a rather abstract definition, it suggests that practices can be seen as coordinated 'entities' that are reproduced and changed through concrete 'performances' (i.e. people enacting a practice). Phrased in terms of Giddens's (1984) structuration theory, practices entail both structure (as an entity of related elements) and agency (concrete enactment and performance). The practice of showering, for instance, entails material elements (piped infrastructure, pumps, water, shampoo), cultural elements (norms of cleanliness, conventions of smell) and social elements (habits, skills and routines of daily showering). But the practice is also continuously reproduced and 'performed' by thousands of people who take regular showers. Practices can also change (often gradually) when new elements are introduced, e.g. power showers, new norms, new cultural expectations. In sum, the practice itself (what people do, how they do it and what this does) becomes the focus of analysis, shifting attention away from moments of individual decision making. From this view, potential for changing patterns of consumption does not depend on educating or persuading individuals to make different decisions, but on transforming the nature of the practices themselves (Warde, 2005).

Most practice theorists view practices as constituted from some combination of recognizable, identifiable elements. The precise configuration of elements that is taken into account does however vary. Reckwitz (2002: 249–250), for instance, proposes the following list of elements: "forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge. A practice (…) forms so to speak a 'block' whose existence necessarily depends on the existence and specific interconnectedness of these elements". Because such a list of elements is difficult to operationalise empirically, I follow Shove et al. (2012), who conceptualize practices as constituted of three interlinked elements: material, competence and meaning. The practice of laundry, used as the basis of a case study below, serves as a good illustration of this. The *material* element refers to physical objects such as the tools, tangible products and infrastructures. In the case of laundry this includes the machines and equipment (washers, dryers, drying racks, laundry baskets, iron and ironing boards), the household infrastructures (plumbing, airing cupboards, washing lines), and consumables (detergents, softeners, stain removers). *Competence* refers to the skill and know-how of practitioners. Many skills are mobilized during the range of procedures which constitute the practice of laundry including: deciding which items to wash, sorting into loads, selection of wash setting, temperature, detergents and mode of pretreatment (including procedures of bleaching, stain removal); drying, ironing, folding and storing clean items. In addition know-how is required for the coordination of these tasks within constraints of space and time. *Meanings* refer to symbols, norms and collective conventions that govern action. In the case of laundry conventions of cleanliness (or what 'clean' means) are important and have been shown to shape how laundry is done over time, particularly in respect to the frequency with which clothes are laundered (Shove, 2003).

The paper advances three specific points which emerge from adoption of a practice-based perspective which are relevant to understanding the diffusion and uptake of new products or services by consumers: 1) practices have internal dynamics e.g. differentiation 2) the strength of the linkages between elements within a

[1] Not all economic theories focus on rational decisions. Behavioural economics, for instance, studies bounded rationality and habits. Additionally, certain marketing theories focus on 'irrational' consumer behaviour (thank you to one of the anonymous reviewers for suggesting this point).

practice varies (I differentiate between tight and loose coupling), and 3) the relationship with other practices has consequences for resistance against deliberately introducing new elements. Each point will be elaborated below.

2.1. Practices are dynamic

Consumer practices are not static *before* the introduction and uptake of new products and technologies. Instead, Warde (2005) argues that practices are inherently dynamic "by virtue of their own internal logic of operation as people in myriad situations adapt, improvise and experiment" (p. 141). Although practices are shared between practitioners, there is also variety in specific performances. When variations are consistently reproduced, to the extent that they shape subsequent performances, a practice can be viewed as being on a trajectory of change (Southerton et al., 2012). Variations can be introduced by new groups engaging in a practice, as for example a new generation who challenge existing orthodoxies by introducing new skills, or ideas of how things should be done (Warde, 2005). A particular kind of internal dynamic relevant to the diffusion of new products, is *multiplication* and *diversification*, in which existing practices differentiate into various sub-practices. Warde (2005) gives the example of the diversification of car driving (initially for commuting and social visits), which differentiated into off-road driving with SUVs. This differentiation resulted in multiplication in the types of practice that exist around driving, each with associated forms of materials, skills and meanings. Such differentiation processes have consequences for producers for whom differentiated practices can constitute new markets for their products and opportunities for product differentiation. For example, practitioners who engage in tennis, football and running, are sold different types of equipment and apparel to both enable participation and to signify competence. The relevance for uptake of innovations is that new products may diffuse more easily if they align with ongoing internal practice dynamics. This also means that diffusion may be better understood by investigating alignment processes than by asking about 'barriers'.[2]

2.2. Elements within a practice can be tightly or loosely coupled

The configuration of Shove's three elements underpins the shape of a practice; the patterns in what people do and how they do it. Taking inspiration from the literature on "modular innovation" (Sanchez and Mahoney, 1996), I suggest that the *strength of the linkage* between elements is also important with respect to change within a practice. When the elements are "loosely coupled" (Simon, 1973), it is possible to change individual elements without making changes in other elements of the practice. When elements are "tightly coupled" (and each strongly dependent on the other), changes in one element also require changes in another element or reconfiguration of the relationship between them. For diffusion of new products, this means that uptake within loosely coupled practices may occur without substantive changes in competences and meanings. For practices with tighter coupling between elements, such uptake would be more disruptive to the practice as a whole, requiring synchronous changes in other elements.

2.3. Practices are linked to other practices

To understand a focal practice, one should not only look at its internal dynamics, but also at its linkages with other practices. As Warde (2005: 149) suggests at the end of his seminal paper, these external linkages are an understudied topic in practice theory: "Finally, there is a question, much avoided in theoretical expositions, of how different practices affect one another, for surely understandings, knowledge and orientations transmigrate across boundaries". Examples given by Warde (2005) of potential mechanisms for inter-practice influence include lessons learned, innovations borrowed and procedures copied, the implication being that external practices may contribute to the dynamic of a practice. My specific proposition is that linkages with other practices will have consequences for stability, which is particularly relevant when considering deliberate interventions aimed at stimulating diffusion within an existing practice. Consequently, those practices which share elements with other practices are likely to be more resistant to purposive intervention than those which are less interlinked.

3. Methodology, case selection and data sources

To illustrate the value of practice theory and the usefulness of the three specific insights, I adopt a case study methodology, which is appropriate to study a phenomenon in relation to its real-life context (Yin, 1994). I use a comparative case-study research design, because this enables making contrasts and comparisons which help bring out salient points of a conceptual framework. I selected energy efficient lighting and low temperature laundry as case studies for two reasons. Firstly, they represent sustainability cases in which intervention to stimulate diffusion of an innovation within an existing consumer practice has met with some success. This enables analysis of the patterns of diffusion, which is not possible for most SPSS innovations which have experienced limited uptake or remain small scale, as noted by Ceschin (2013). Although the cases are not SPSS innovations, they offer an opportunity to examine social practices in relation to the diffusion of sustainability innovations. The relevance of the insights for SPSS are explicitly discussed in Section 5. The second reason for case selection was that the two innovations contrast in terms of types of transformation in consumer practices. While energy efficient lighting depends on product substitution, low temperature laundry requires existing products to be used in new ways.

The case studies draw on data from primary and secondary sources. Primary data were gathered from in-depth, semi-structured interviews with market leading firms at the forefront of innovation in each sector (Procter and Gamble, Philips). Interviewees came from different business functions including marketing, product development and CSR, which enabled exploration of both sustainable innovation strategies and understandings of consumer responses. Interviews were also conducted with industry trade associations operating at the National (UK) and European levels (UKCPI[3]; AISE[4]; ELC[5]; LIA[6]; PLDA[7]) to explore initiatives to stimulate innovation, including regulation, new product development and consumer demand. Data were also gathered from secondary sources such as consumer research reports, trade and government publications (on industry structure, regulations and market dynamics), CSR reports of innovating firms, and academic studies of consumer lighting and laundry practices published in peer-reviewed journal articles.

[2] The 'barrier' language implicitly takes an artefact focus, which sees wider contexts as opportunities or 'barriers to be overcome'.

[3] UK Cleaning Products Industry Association.

[4] International Association for Soaps Detergents and Cleaning Products.

[5] European Lamp Companies Federation.

[6] UK Lighting Industry Association.

[7] Professional Lighting Designers Association, previously the European Lighting Designers Association.

4. Analysing interventions and uptake of sustainability innovations in lighting and laundry practices

The analysis of each case focuses on the responses to purposive intervention toward stimulating sustainability innovation within the practices of lighting and laundry. I first introduce the cases, outlining the forms of intervention and contrasting patterns of uptake by UK households. These differences are then explained using the practice-based framework and the three insights introduced in Section 2.

The two cases differ in terms of relative success. Innovation in household lighting has resulted in a significant decline in energy use in recent years and is held up as something of a success by environmental groups and governments (Smith, 2010). Innovation in laundry practice has made far less progress, accounting for only a small proportion of laundry undertaken by consumers in the UK (AISE, 2013). To elaborate the contrast, the cases are discussed further below in terms of interventions and uptake.

The lighting industry considers domestic lighting technology to be in the midst of a major transition (Waide, 2010,[8] Interview Philips, 2013 Interview ELC, 2012). Traditional incandescent bulbs have been removed from the market, and consumer awareness of energy efficient light bulbs and associated energy savings is high (Mintel, 2010; Wall and Crosbie, 2009). Energy use in domestic lighting is on a steep downward trajectory (DECC, 2010), as is the use of traditional incandescent light bulbs (DECC, 2010). However, despite this 'success' in simulating energy saving in domestic lighting, a closer look at consumer responses reveals some unintended consequences to intervention in lighting. As outlined below, interventions have focused on stimulating replacement of incandescent bulbs by CFL. However, rather than uptake of CFL bulbs it is halogen bulbs which have replaced traditional incandescent bulbs (DECC, 2010; Mintel, 2010; Wall and Crosbie, 2009).

The availability of more efficient technologies in the form of compact florescent light bulbs (CFL) led to energy saving campaigns to reduce household energy use in the UK since the 1990s (Market Transformation Programme, 2008). Initially the main policy approach was to subsidize the distribution of CFL to consumers through the electricity industry (Waide, 2010; Smith, 2010). Despite distribution of over 17 million CFL to homes between 1994 and 2000 (Defra, 2002), energy use by incandescent light bulbs continued to rise, increasing 11% through the 1990s (Defra, 2002). In 2007 the EU announced an international ban on the sale of incandescent light bulbs, to be implemented by 2010.[9] In the UK this prompted phase-outs of some types of incandescent bulbs by several large retailers (Smith, 2010). This was accompanied throughout the 2000s by government subsidised distribution of up to 100million CFL bulbs to UK consumers through joint initiatives including energy companies and retailers (Interview Philips, 2013, Smith, 2010). In 2008 the most popular incandescent bulbs (100 and 60 W varieties) were removed from sale and all varieties of incandescent bulbs had been banned in the UK by September 2012. Despite these coordinated interventions to stimulate the market for CFL, as illustrated in Graph 1, these interventions have had limited impact on the use of CFL in homes. Additionally, LED use in homes, widely touted as a sustainable lighting solution has, so far, experienced very limited take up (EU, 2011; Waide, 2010).

In the second case, intervention to promote the adoption of low temperature laundry by consumers has been led by the detergent industry. This took the form of introducing low temperature capability by a leading detergent brand, accompanied by brand-led advertising and information campaigns promoting the benefits and urging consumers to wash at 30°C. Subsequently, other detergent brands joined in the promotion of low temperature laundry. Consumer information and awareness raising initiatives were orchestrated at national and international levels by industry trade associations (Interview, AISE 2012, Interview UKCPI 2012). In the UK the issue has also been identified as a target for government and NGO consumer energy saving campaigns. The positive effect was that the proportion of UK consumers who report washing at 30 °C rose considerably, from 2% in 2002 to 17% of consumers in 2007 (Defra, 2011), a trend which has continued (AISE, 2013). However, consumers vary the temperature at which they launder clothes (AISE, 2013; Defra, 2011, 2012). Consequently the overall volume of laundry conducted at low temperatures remains lower than the proportion of consumers engaging in low temperature washing. So while significant change in UK washing practice is evident, low temperature laundry remains less favoured than higher temperature laundry.

The following three sections illustrate the significance of processes of appropriation and appreciation of lighting and laundry to the understanding of the differential success between the cases. Each section discusses how one of three insights contributes to the explanation.

4.1. Practices are dynamic

One approach to examining internal practice dynamics is to explore how the practice has changed over time. Taking energy as a proxy, practices of home lighting and laundry have both grown considerably since the 1970s (DECC, 2010)[10]. In both cases the dynamics of multiplication and differentiation (Warde, 2005) can be observed.

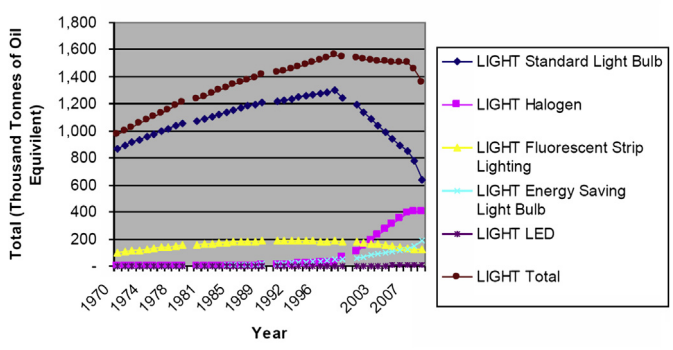
In the case of lighting, increase in the number of lights used by households has been accompanied by a proliferation in the types of lights installed (Mintel, 2010). Different forms of lighting are used to meet different needs, which have moved beyond illumination to the provision of aesthetic value, atmosphere, convenience and safety. The role of lighting in achieving aesthetic effects and ambience within the home is now particularly important to consumers, who attempt to emulate the appearance of lighting as presented in magazines and on television (Crosbie and Guy, 2008). This has created opportunities for many different types of lights to be included in homes, such that lighting a room with a single ceiling light has been replaced by combinations of uplighters, ceiling, wall and side lamps. This diversification of the lighting practice is further evidenced by a proliferation of security lights for safety, and outdoor lights for convenience and to add aesthetic value to gardens, buildings and other outdoor areas.

These endogenous dynamics have had consequences for the uptake of new types of light bulbs. The assumption that one kind of bulb can replace another is based on the premise that light is devoid of social meaning. However, as noted above the ongoing dynamic of the lighting practice, is that lighting has become imbued with an increasing number of meanings, which resulted in the diversification and multiplication of lights. The increasing use of lights to create ambience, and the accompanying shift in meaning from one aspect of illumination (measured in brightness),

[8] "The global lamp (bulb) market and industry is clearly undergoing a major transition" Waide: 2012p75.

[9] Some voluntary phase outs from supermarkets were also underway when this was introduced. Light bulbs have also been the subject of eco-labels and a focus of activity under the UK's Carbon Emissions Reduction Target (CERT) scheme and building regulations.

[10] Energy can be used as a reasonable proxy because both appliances (washing machines and light bulbs) are getting more rather than less efficient.



Graph 1. Changing sources of household illumination.
Source: Department of Energy and Climate Change (2010)

to include ambience (measured in qualities of light such as colour and softness) resulted in unexpected consequences for the uptake of CFL. CFL were rejected from use in some contexts, or adopted in combination with other types of lights through which the range of existing social meanings and value of a well-lit home could be reproduced.

In the second case, the dynamic of the laundry practice can be observed in the increasing frequency and number of loads being laundered. UK Households now conduct on average 285 cycles per year (Defra, 2012). This has been attributed to changing conventions of cleanliness. Today, items of clothing are laundered not only to remove dirt, but for a whole host of purposes such as to remove odour, to disinfect, to 'freshen up', as well as after wear by other people or in other contexts (Interview P&G, 2012, Mintel, 2011; Shove, 2003). This multiplication of reasons to do the laundry manifests itself in the increased frequency of washes, and the shortened time span in which clothing is seen to be ready to wash. It is these types of alteration in meanings, of what clean means and how this should be achieved, which underpin (and constitute) changes in the practice.

This dynamic, in which washing clothes is now imbued with a range of social meanings, has offered an opportunity for the uptake of low temperature washing. The pattern of (non)adoption of low temperature washing is connected to this diversity of meaning. Leading laundry detergent producers claim, based on extensive consumer research, that adoption of low temperature laundry follows a distinct pattern. Consumers initially adopt low temperature washing of delicate items followed by every-day clothes, first dark then light items. White linen, towels and baby clothes are less likely to be washed at low temperature, and only after the new procedure has been trialled with other items. So, the adoption of the new procedure is fragmented within the practice. For example laundering to meet "hygienic" conventions, evoked for items such as baby clothes, is less receptive to low temperature washing. This ongoing dynamic, in which laundry fulfils an increasing range of needs, has shaped the diffusion of low temperature, enabling it to take hold in some instances but not others.

Attention to the internal dynamics of practice provides understanding of why the substitution of CFLs for incandescent was not straightforward. The social meanings embedded in the lighting practice were not wholly satisfied by CFLs. While consumers accepted them in some contexts, they turned to alternative types of light in other contexts. Similarly, the multiple meanings of laundry made it possible for 30°C laundry to be adopted, but only in some instances, in which existing social meanings would still be reproduced. Both cases demonstrate that uptake is shaped by the ongoing dynamics of the practice, and indicate that diffusion is more likely when the innovation is aligned with these.

4.2. Elements that constitute practices may be tightly or loosely coupled

Examination of how the adoption takes place within the two practices reveals different relationships between the three elements within each practice. While the elements of laundry are tightly coupled (each strongly shapes the other), those of lighting are less so. I argue that the strength of coupling has consequences for the diffusion of innovation within the practice.

Until ten years ago, light bulbs used in homes were predominantly incandescent, found in two forms of fixing: bayonet and screw-in (Mintel, 2010). The type of bulb used was dependent on the light fitting installed and had little implication for how the light was used, or the quality of light that was produced (Interview LIA, 2012). The form of the materials, the skills deployed in using them and the meanings produced were not closely dependent on the nature of the other elements – referred to as "loosely coupled" in section 2. When new bulbs were adopted this characteristic enabled a relatively straightforward replacement of one artefact with another, while the practice continued without disruption. The uptake of CFL required compatibility with other artefacts (within the material element of the practice) such as light fittings, lamp shades and dimmer switches. CFL were initially rejected by consumers because of problems in this material compatibility with regard to size, shape, not being "dimmable" as well as the quality of light produced (Interview LIA, 2012, Interview Philips, 2013, Mintel, 2010). This was resolved through redesign of the product and uptake was promoted without alteration in the skills or meaning attached to the product or its use (Interview Philips, 2013). Indeed little skill is required in switching on lights. Competence is implicated, however, in design and internal decoration, aimed at creating appropriate combinations of lights to accompany particular activities. This competence is enacted only intermittently when lights are purchased, installed and arranged within the home.

In contrast the practice of laundry exhibits tight coupling between its constituent elements. Contemporary understandings of clean clothes (meaning) are deeply linked to the use of automatic washing machines and synthetic detergents (material). These material elements are designed to produce particular aromas (e.g. floral), textures (e.g. softness) and appearances (e.g. brightness), which signal that clothes are clean (Shove, 2003; Interview P&G, 2012). These qualities (manifestations of the meanings of cleanliness) recursively shape consumers' expectations of laundry, and competent performance (skill) is judged accordingly as clothes are washed after failing the "sniff test" and to revive freshness rather than to remove dirt (Shove, 2003).

This close coupling of elements meant that in order for low temperature washing to be adopted changes across the practice were required. Not only must washing machines contain 30°C programs and detergents work effectively at low temperatures but consumers' criteria for sorting clothes and selecting programs must also adapt. Crucially the meaning of low temperature laundry must also change to become a normal part of the laundry repertoire, compatible with expectations of how to produce clean clothes. Detergent producers have observed both of these aspects of the laundry practice, and anticipate new markets for auxiliary laundry products (such as load additives and pre-treatments) to emerge as low temperature washing diffuses and consumers incorporate new procedures (Interview P&G, 2012). Consumer perception of the incompatibility between low temperature and effective clothes cleaning is viewed as the key challenge around the adoption of low temperature laundry (Interview AISE, 2012; Interview P&G, 2012). In contrast, the key challenge for the lighting industry – producing energy saving bulbs with the performance of traditional bulbs (in colour range, shape etc.) has been (and continues to be) solved by

technological innovation and product design (Interview LIA, 2012). It appears that the meanings and skills reproduced through the use of materials may be more resistant to change than the materials themselves. Particular manifestations of the close coupling of these elements, evident in the practice of laundry, therefore warrant further exploration.

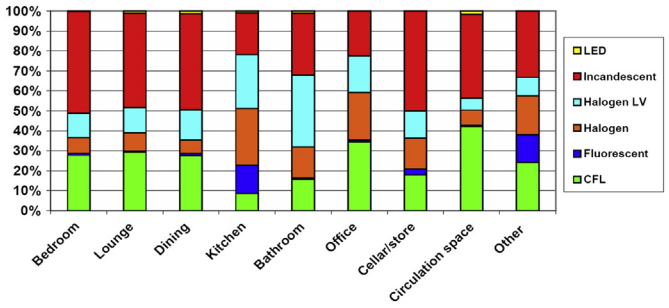
Meanings and skills are entangled within procedures of doing the laundry. The temperature used for washing is an example of this. While warm temperatures have a physical impact on the laundry process, there is also a strong social aspect. This is visible by comparison of national variations in laundry temperature in which 80% of hot water washing occurs in just eight countries in Europe, while other developed countries, for example Spain and Japan launder clothes predominantly in unheated water (AISE, 2013; Interview P&G 2012; Whilhite et al., 1996). It is likely that differences in the temperatures are compensated for by alteration in other procedures, such as pre-treatment (e.g. soaking) or degree of mechanical agitation (e.g. scrubbing). Whilhite et al. (1996) analysed the energy use in households including clothes washing, and noted stark differences in the laundry temperature between Norway (average temperatures between 50 °C and 60 °C) and Japan where laundry is conducted at room temperature. This difference was attributed to cultural differences in the link between the materials and the meaning, in that "the Japanese do not share Westerners obsessive link between hot water and hygiene" (Whilhite et al., 1996: 801).

The design of artefacts is also important in reproducing linkages between practice elements. This can be observed by comparison of washing machine designs and the adoption of low temperature washing between the UK which is relatively resistant, and the US where specifically cold-water detergent brands have been successful. What people do, and the skills required, is partially scripted by the design of artefact. In the UK washing machines are designed to include many combinations of settings, to which new programs, such as low temperature, are added (Interview P&G, 2013). This enables consumers to exercise judgment and skill while using the machine, with varying implications for individuals' performance of laundry (some practitioners utilise the range of settings while others do not). The collective result however is that discretion in machine use, and the choice of temperature, is expected. In fact washing machines designed with simple fascia and few settings are not successful in the UK market (Interview P&G, 2013). This is in contrast to other markets, for example the US or Spain, in which many machines contain only three temperature settings of "Hot", "Warm" or "Cold". These markets, in which skills in temperature selection are less tightly coupled to the meaning of doing the laundry have proved less resistant to uptake of low temperature washing than the UK (Interview AISE, 2012; Interview P&G 2012).

The above discussion shows that the degree of coupling between elements (loose and tight) shapes the uptake of innovations into the practice. The extent to which meanings and skills of the practice are shaped and reproduced by existing material configurations appears to be particularly important for the uptake of new products, or the use of products in new ways.

4.3. Practices are linked to other practices

The diffusion of CFL illustrates how the uptake of new products can be shaped by linkages with other practices. Graph 2 shows that the types of light bulbs installed, and the uptake of CFL varies across different rooms within the house, which are associated with different practices. While some practices, such as working, which takes place in the office, have proved more receptive to the incorporation of CFL, other practices such as cooking or eating in the kitchen, have proved less receptive. Lighting has many external



Graph 2. Proportions of installed light bulb according to room type.
Source: Defra 2012

linkages because it is a practice which facilitates other practices to occur (i.e. we do not use light for its own sake, but to read, cook or create a cosy living room). The differentiation of the lighting practice, and the uptake of new products, is therefore shaped by the conventions of those other practices. So not only is lighting imbued with multiple meanings and values (such as warmth, colour, and lux), but these meanings will be brought into play depending on the practice that lighting supports. So a lounge might at one moment be brightly lit to play a board game, switched to low lighting to watch a film, lit for cosiness and warmth for a dinner party and so on. A room is lit for the practices that take place within it. The wider implication is that diffusion may be more complicated for multi-practice spaces (which in this case require a variety of lights). In contrast spaces which host fewer practices (such as hallways and landings) appear to require less variety in light form and are more receptive to substitution and uptake of CFL.

In contrast to lighting practice, which is linked to other practice through co-performance, laundry is linked to other practices through conventions of cleanliness which are reproduced across many aspects of daily life. A good example of this is the linkage between temperature and effective cleanliness, which exists across many practices. In the UK, the association is reproduced in the domains of personal hygiene (e.g. bathing and hand washing), food preparation (e.g. dishwashing) and housekeeping (e.g. floor washing and window cleaning). While these associations may be taken for granted as "common sense" by consumers, as noted above, they exhibit national variations, illustrating their culturally embedded character. In Spain for example, both dishwashing and the majority of laundry take place at low temperatures (Interview AISE, 2012, Interview P&G, 2012). The sharing of elements and associations across practices confers *resistance* to purposive intervention in the laundry practice. The consequence for uptake of low temperature laundry is that diffusion has been constrained by widely shared meanings, that cold water does not clean clothes (Interview P&G, 2012) rather than material outcomes as in the case of lighting.

5. Conclusions and discussion of relevance for SPSS

The paper has aimed to address an imbalance in the concept of Sustainable Product-Service Systems (SPSS), namely the tendency to focus mostly on questions of design and management in the realm of "production". The paper has therefore developed a deeper understanding of the demand side, drawing on the sociology of consumption and practice theory. Three insights have been presented and used to analyse contrasting diffusion patterns of sustainability innovation within two practices (laundry and lighting). The two cases illustrate the importance of looking beyond acquisition to explain the demand-side dynamics underpinning the diffusion of innovations. The way in which products are

appropriated and appreciated (or not) during usage were shown to have consequences for patterns of uptake. First, the internal dynamics of practices influence the pattern and extent of diffusion of an innovation; innovations which are not aligned with ongoing dynamics are likely to encounter resistance. Second, diffusion is shaped by the configuration of the practice elements, in particular the degree of coupling (tight or loose). Third, when elements of the focal practice are linked to or shared with other practices, this may create resistance to diffusion, as was the case for laundry, where high temperature tends to be associated with broader cultural notions of cleanliness. The discussion below elaborates the relevance of the three insights for the understanding of the (lack of) diffusion of SPSS innovations.

The first insight suggests that it would be better to understand SPSS as 'transforming' rather than 'meeting' consumer needs. Many understandings of SPSS focus on developing new and more sustainable ways of meeting existing customer needs (see for instance Mont's (2002) definition cited in the introduction). Strategies to increase user acceptance therefore aim to match SPSS design with consumer needs. The problem with this approach is the underlying assumption that the "need" itself is stable, and exists beyond the practical and cultural context within which it is met. Contrary to this assumption, the practice-based framework emphasises the heterogeneous and recursive nature of the creation and existence of needs. It also highlights that the diffusion of SPSS is likely to coincide with the transformation of the practice and the need itself. SPSS innovations cannot therefore be mapped directly onto existing practices and needs, but should be approached as a transformational alignment process in which practices (and needs) co-evolve with new products, business models and infrastructures.

The second insight suggests that practices with tightly coupled elements are likely to be more resistant to the absorption of innovations, because of the requirement for accompanying alternations in skills and/or meanings. In cases where this involves the alteration of meanings, as in the case of low temperature laundry, diffusion is likely to be particularly difficult. When elements of a practice are more loosely coupled, diffusion can occur with relatively little disruption across the practice. The uptake of CFL bulbs for instance, occurred without the need for alteration in the meanings or skills of the lighting practice. The relevance of this insight for SPSS is that it would help understand why, for instance, the diffusion of SPSS in car driving would be more difficult than the diffusion of SPSS for power tools for home maintenance. In the practice of car-driving, the various elements (artefact, meaning, and skill) are relatively tightly coupled, with historians (e.g. Sachs, 1992) particularly highlighting the role of meaning and cultural discourses (linked to the joy of driving, freedom and individuality, adventure) in stabilizing car use. In the practice of do-it-yourself (DIY), on the other hand, the various elements are more loosely coupled, which means that practitioners could shift to alternative modes of provision without greatly affecting the skills required to maintain your home and the meaning of doing so. To take this idea one step further, one might argue that meanings often provide the deeper glue for (tight and loose) coupling between elements. Mont (2004), for instance, suggested that ownership and the symbolic value of owning products often hinders the uptake of SPSS. This may be especially the case for highly visible products embedded in salient cultural discourses (such as cars). From a practice-based perspective one would therefore analyse SPSS with regard to the degree of coupling between meanings and other practice elements. Stimulation of SPSS diffusion within practices where meanings are tightly coupled will require greater investment in the presentation of alternative images and visions of what it means use particular arrangements of provision.

The relevance of the third insight is that SPSS diffusion will proceed more easily within practices which are less extensively linked to other practices. For example, the diffusion of SPSS within the practice of gardening will require less resources to stimulate than within the practice of driving, which has many external linkages to other practice such as shopping, commuting, social visits, taking children to school.

This discussion shows that the practice-based framework and specific insights have relevance for the SPSS debate, highlighting factors and mechanisms that may enable or constrain diffusion. Future research can further enhance this relevance by applying the framework directly to SPSS innovations. It would also be interesting to further explore and elaborate the second and third insight, which represent novel ideas in practice theory. This could include further operationalisation of the ideas of element-coupling and inter-practice linkages, as the basis for developing indicators to measure and predict SPSS diffusion.

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