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How to engage households in energy demand response solutions?

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Abstract

Within the smart energy and smart grid field, Demand Response (DR) is expected to play an important role in balancing energy consumption with intermittent energy production from renewable sources in the future. This DR vision, in many cases, relies on active involvement of households in actions aimed at time shifting their energy demand. However, DR solutions targeted households have had a rather limited diffusion and impact so far, and it has proven difficult to ensure sustained user engagement.

Based on practice-theoretical approaches to residential energy demand, this paper takes as its starting point that new methods to involve households are required if we are going to design DR solutions that will be successful in engaging households in DR actions. As a contribution to this, the paper explores what role learning might play in realizing DR solutions based on active involvement of households. Here, learning is understood as both the self-reflection about own habits and the appropriation of new practices. The role of learning is explored by, first, identifying and discussing the types of situations and dynamics in everyday life that can initiate processes of learning. Such situations or dynamics are termed "initiators of cultivation", and examples include social feedback, encountering others' ways of doing, embodied sensory feedback, etc. Secondly, we discuss to what extent existing DR approaches are employing these situations or dynamics in order to foster instances of learning in relation to moving everyday practices in time. The conclusion is that the scope of present DR approaches is quite narrow and only addresses a limited number of possible initiators of cultivation. Therefore, the paper provides some first ideas on how to make DR designs better at initiating processes of learning, which could lead to more engaging and successful DR solutions. This part informs policy-makers as well as DR solution designers.

The paper is based on a literature review. We are not necessarily implying that new learning approaches "by default" result in efficient DR solutions that are successful in changing the energy consumption profiles of

households. This is an open question, which needs further theoretical and empirical exploration to be answered, but we hope that our paper contributes to the foundation of such further investigation.

Introduction

For many years, Demand Response (DR) has been assigned a key role in balancing the energy consumption of the demand side with intermittent energy generation of renewable sources like wind and solar energy (Darby & McKenna, 2012; Goulden et al., 2018). The vision of DR relies often on the idea of an active involvement of households in manual or automated time shifting of their own energy consumption; for instance, by moving dishwashing or laundering to hours with a surplus production of renewable energy in the electricity system (e.g. during night hours). Many DR programmes involve variable electricity pricing, such as Time-of-Use pricing, real-time pricing or dynamic pricing (Strengers, 2013), as an indicator of the status of the energy system. The assumption is here that households will react to these price signals by shifting consumption away from hours with high prices and to hours with low prices (Darby & McKenna, 2012). However, despite numerous trials and pilots in many countries, DR programmes aimed at time shifting of energy consumption in households have so far had a limited impact. (Goulden et al., 2018; Hargreaves, 2018; Strengers, 2013; Torriti et al., 2010)

A number of studies based on practice theories have explored the reasons for the limited effect of DR programmes and found that the underlying approach behind most DR solutions (and smart grid and smart home solutions more generally) towards active involvement of households is misleading (e.g. Hargreaves et al., 2010; Hargreaves, 2018; Strengers, 2013). For instance, Strengers (2013) observes that dynamic pricing, as most smart grid approaches more generally, is based on a misleading understanding of the individual (energy) consumer as a *Resource Man* who is an "efficient and well-informed micro-resource manager who exercises control and choice over his consumption and energy options" (ibid.: 34-35). Compared to the conceptualisation of the consumer as an informed micro-resource manager, social practice theories offer an alternative approach, which places *social practices* as the centre of analysis (e.g. Gram-Hanssen, 2010; Shove & Pantzar, 2005; Strengers, 2013). In this perspective, energy consumption is an outcome of people performing everyday practices like showering, cooking, laundering and making a comfortable home, e.g. in relation to indoor temperature (e.g. Shove & Walker, 2014; Royston, 2014). This results in two key observations: First, people are in general not recognizing energy consumption as an activity in itself, and they often find it difficult to establish the link between daily practices and the corresponding energy consumption. Second, if the goal is to time-shift energy consumption, this means that people need to time-shift their everyday practices because of the, in most cases, concurrence between the performance of a practice and its related energy consumption. The latter might have significant influence on the overall organization of the household members' everyday life, which is constituted by a complex of mutually dependent practices (Shove & Walker, 2014); e.g., moving dinner cooking in time potentially involves re-organising and time-shifting other practices such as working and school hours, sleeping hours, shopping, recreational activities in the afternoon and evening (e.g. organized sports activities) and entertainment. Several of these related practices are difficult to time shift, if possible at all, due to their nature as collective rhythms (see also Friis & Christensen 2016; Nicholls & Strengers, 2015).

For these reasons, most DR approaches, such as those based on Time-of-Use pricing, can be criticised for applying a too simplistic and optimistic approach to realizing energy time-shifting. Also, if DR solutions are going to have a significant impact on the energy consumption profiles of households, this requires innovation in how people perform their everyday practices on both a collective and individual level. Such an innovation is difficult to imagine without processes of learning where householders try out, negotiate and gain experiences with new ways of doing things. Existing DR programmes have mostly failed to invite the participants to take part in such learning processes due to their idealization of simple, incentive-based feedback (e.g. providing variable electricity prices) as a mediator of behavioural change (Hargreaves, 2018).

This paper explores the possible role of learning processes in realizing DR in households. This is done by discussing what kind of situations and dynamics that can activate processes of learning in general (not specifically linked to smart grid or DR solutions). Related to this, we also discuss to what extent existing DR programmes are addressing these situations or dynamics. Based on this, the paper provides some initial ideas on how to make DR programmes better at making everyday practices open for processes of learning, which could inform future policies on how to design DR solutions. Different definitions of the term "demand response" exist within literature, but in this paper DR is limited to solutions aiming at shifting energy consumption in time, typically in order to achieve peak shaving or balance consumption with intermittent renewable energy production.

The paper is based on a review of existing literature within practice theory-inspired studies of DR and energy feedback targeted households. We have also included energy feedback (i.e. energy consumption feedback aimed

at making householders save energy – and not necessarily time shifting it like in DR) within the scope of the literature review as the main aim of this paper is to identify generic types of situations and dynamics that can create processes of learning on the basis of previous studies. The discussion of the paper might at some instances appear speculative, but we believe that such speculation is needed to open new avenues of research into the role of learning in smart energy approaches (and sustainable transition more broadly). This could prove important to break the stagnation that seems to have characterized the smart energy field within the last years with regard to DR approaches aiming at active involvement of households (see, e.g., Hargreaves, 2018).

Only few studies have previously introduced the learning perspective to the exploration and development of smart energy solutions and energy feedback (e.g. Burchell et al., 2015; Christensen, 2014; Simcock et al., 2014), while – to the best of our knowledge – none have related it to DR solutions. Therefore, we believe there is a need to explore this further. That said, we are not necessarily implying that introducing new learning approaches by definition leads to efficient DR solutions that are successful in promoting active time shifting and, thereby, changing energy consumption profiles of households. This remains an open question, which needs further theoretical and empirical investigation. It is our hope that this paper can contribute to develop the foundation for further research.

How processes of learning are initiated

Most of our everyday practices, such as cleaning, cooking and doing the laundry, are mundane and performed as unconscious routines. Changing these practices therefore takes effort and only happens in certain situations where our daily routines, in one way or the other, are brought up to reflection, negotiation or some other form of revision. One way of conceptualizing this is proposed by Wilk (2009), who draws on practice theory and the concept of habitus (Bourdieu, 1984), which refers to the embodied mental and physical habits and dispositions (e.g. mental schemes) through which we as human beings perceive and act in the world. On basis of these inspirations, Wilk has developed the analytical model shown in Figure 1.

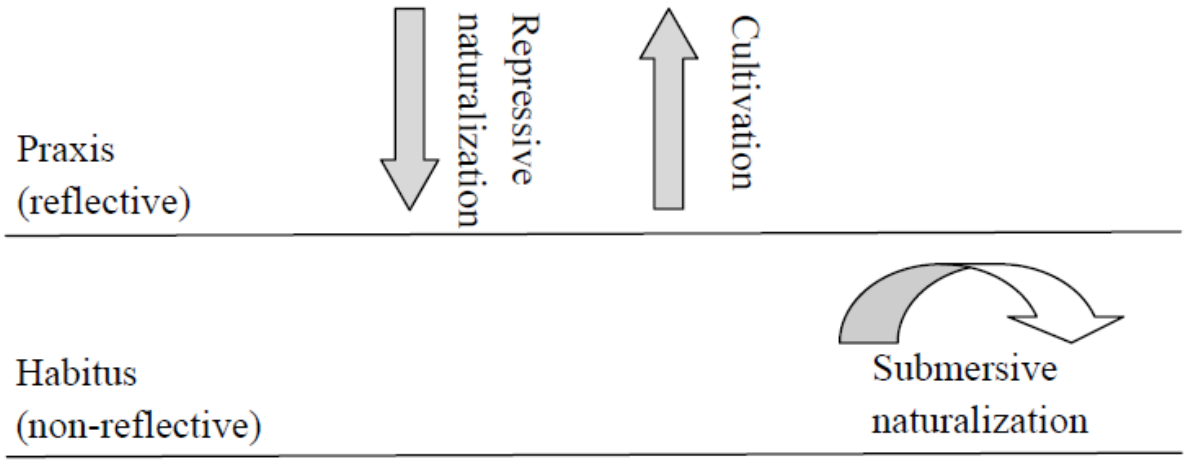

Figure 1. Processes of cultivation and naturalization (based on Wilk, 2009)

According to Wilk, unconscious habits and routines can be made visible to us and become subject to reflection through the process of *cultivation*. This can be fostered in various ways, e.g.: Other people can make us aware of habits that we do not think about ourselves or we can experience a conflict between different routines, which makes it necessary to adjust how we perform these routines or habits. The opposite of cultivation is *naturalization*, which are "processes which push conscious practices back into habitus, or keep them from surfacing into consciousness in the first place" (Wilk, 2009: 150). Often, practices never surface from the realm of unconscious routines (habitus) because they are so widespread and closely associated with the social and cultural understanding of "normal behaviour" that it takes efforts to make people aware that these are contingent and can be subject to change. Examples could be the indoor temperature or the daily shower. As this kind of routines "remains thoroughly submersed in the habitus" (p. 150), Wilk terms this submersive naturalization, and how these are performed is typically only made subject to reflection if shared conventions and cultural understandings are changed. People might be made aware of their naturalized practices in cases of disruption, e.g. during blackouts – but this does not necessarily make people reconsider how the practices are performed,

and the performance of the naturalized practices are typically resumed as soon as the temporary disruption ends. A second type of naturalization is repressive naturalization, which describes how people often force a practice back into habitus if alternatives have challenged this practice or if it is a new practice that people intend to turn into a normal routine. An example of this could be trying to change one's diet or learning a new routine of turning off the standby consumption of electrical appliances.

An important implication of the theoretical observations made by Wilk (2009) is that without cultivation, it will not be possible to make householders think about their own practices, and therefore they will not realise possibly relevant DR actions. Typically, DR and energy feedback solutions aim at promoting cultivation through providing (visualised) information about energy consumption and indicators of the energy system status (e.g. variable electricity prices) to households via technological platforms such as smart phone apps or in-home displays. In most cases with limited success (e.g. Darby, 2010; Hargreaves et al., 2013), because – among other things – it takes competences to interpret quantified or abstract energy data and linking these to one's daily practices.

A study by Royston (2014) on how people monitor and manage heat flows in their homes on basis of experience-based know-how corroborates Wilk's analytical model. Embodied know-how is essential to our performance of routinized practices and resembles what Schatzki terms as "practical understandings", which is one of four elements that keep nexuses of doings and sayings (i.e. practices) together (Schatzki, 2002: 77). Following this, changing how practices are performed necessarily involves developing new sets of embodied know-how on how to carry them out. On basis of her study, Royston (2014) identifies two interconnected and often simultaneous processes that are important for the development of know-how and how it changes over time. The first is processes of "appropriating, accommodating, interacting and improvising that occur between a person and the materials, flows and social arrangements they encounter in daily life" (ibid.: 154). This includes various types of focused interaction with materials and/or social interaction embedded in social relations; e.g. tinkering with the heating system to learn how to make it fit better with one's habits and needs or learning through interaction with others, such as family members or friends showing their way of "doing heating". The second, and connected, process relates to "the ways in which experiences become absorbed or embedded, and produce lasting changes in the body and mind, as a form of memory" (ibid.: 155). Royston relates this to the Bourdieuan concept of habitus (1979; 1984), and she refers also to Wallenborn & Wilhite (2014) who write about people's ability to learn new physical habits and capacities. This second process resembles the routinisation of new habits and practical skills that Wilk refers to as repressive naturalization. Similarly, the first process that Royston identifies is similar to the process of cultivation in that the social and material negotiations (e.g. to tinker with one's heating system) might be spurred by situations or dynamics drawing the practitioners' attention to the performance of certain practices. However, the first process is also describing a process of learning (through interaction with other people or materials), and in this way hints at what is taking place between cultivation and naturalization in the model of Wilk (Figure 1).

Initiators of cultivation and learning

In the following, we identify the different ways in which cultivation can be initiated and lead to processes of learning. This is done mainly on basis of practice-theoretical literature focusing on energy feedback and DR. Also, it is discussed to what extent the existing mainstream DR programmes are employing the identified "initiators" of cultivation and learning in the design of DR solutions targeted households. Table 1 provides an overview of the identified initiators.

Table 1. Situations and dynamics that can initiate cultivation

Initiator of cultivation	Description	Addressed by conventional DR?	References
Social feedback	Feedback and suggestions from other people on how to perform a certain practice, including normative judgements on the "successful" performance of practices (normative social influence)	To some extent	Strengers, 2013; Hargreaves, 2018; Nolan et al., 2008
Encounter other people's "ways of doing"	Observing other people's ways of performing a certain practice and relate it to one's own performance (normative social influence)	No / limited extent	Nolan et al., 2008
Material feedback	Material environments guiding the performance and evolution of practices; also, changing place of living	No / limited extent	Strengers, 2013; Hargreaves, 2018
Embodied sensory feedback	Bodies as "self-monitoring devices" (Strengers) providing feedback via our senses (visual, olfactory and tactile) and providing cues for changing practices (e.g. feeling cold or hot)	No	Royston, 2014; Strengers, 2013; Hargreaves, 2018
Changes in the complex of everyday practices	Adoption of new practices, discontinuation of previous practices and changes in performance of existing practices might imply changes/adjustments of other co-dependent practices	No	Bech-Jørgensen, 1994
Changes in conventions and shared understandings	Evolving collective conventions and understandings might challenge the performance of existing practices	No / limited extent	Royston, 2014.

Social feedback is perhaps the type of practice feedback that most people know from their own daily living. Following Strengers (2013), this includes verbal comments from friends or family members on how to perform practices. Social feedback often contains an element of normative judgement; e.g. when friends pay compliments to one's cooking (or, correspondingly, the absence of such compliments) or when a partner complains about one's way of cleaning. Whether positive or negative, this kind of normative social feedback contributes to the continuation or revision of one's way of performing practices (see also Hargreaves, 2018). It can be argued that some conventional DR solutions draw on elements of social feedback if they include suggestions on what types of specific actions people should take to time shift their energy consumption to follow the DR signals (e.g. suggesting to postpone dishwashing to off-peak night hours to save money). However, in most cases, DR solutions only provide one simple indicator (typically a variable electricity price), and thus leave it up to the householders themselves to translate this abstract indicator into concrete actions to be made.

Another way of triggering a process of cultivation is by *encountering other people's ways of performing practices*. This might essentially be a variant of the previous social feedback, but without the feedback being vocalized as judgements or recommendations by the others. Examples could be when one observes how other people raise their children or are cooking meals and contrasts this with one's own way of doing this. Through this, one's own way of doing things is relativized (i.e. made subject to consideration and self-evaluation) and one might adopt elements of the observed practice performance in one's own performance. In the extreme case, the encountered practices of other people might be entirely new to one and in this way adopted for the future. This way of learning new practices through imitating others' practice performances resembles what Lave & Wenger (1991) have termed *situated learning*. Lave & Wenger developed their theory of situated learning in opposition to abstract and idealized understandings of learning that typically emphasise this as an individual, psychological-cognitive process focused on adopting abstract and codified knowledge. Instead, they emphasise how learning in most cases is socially embedded and develops through close interaction with others. Learning takes place by the learner taking active part in a socio-cultural community centred on the performance of shared practices. A key concept of Lave & Wenger is the Legitimate Peripheral Participation (LPP), which describes how "newcomers" learn from "old-timers" (i.e. people who have performed the practices for long time and become experts in doing so). Situated learning is about "the relational character of knowledge and learning, about the negotiated character of meaning, and about the concerned (engaged, dilemma-driven) nature of learning activity for the people involved" and "learning is an integral part of generative social practice in the lived-in world" (ibid.: 34-35). Lave & Wenger also introduce the concept of community of practices (later developed further in Wenger, 1998), which is a community of people sharing the same practice(s). While the asymmetrical relation between the "newcomer" learning from the "old-timers" is a key element in situated learning theory, Lave & Wenger emphasise that situated learning can happen in many situations in life. Both social feedback and encountering others' practice performances seem to hold the possibility of situated learning. Indeed, these two types of

cultivation initiators might most likely result in processes of learning if they relate to people that one feels affiliated with; i.e. people that one might share a sense of community with. This type of community-approach has inspired a few energy feedback trials with what appears to be promising results (e.g. the UK community action and communication trial reported in Burchell et al., 2016; see also Catney et al., 2013). However, the examples of community-oriented approaches are few.

A final comment related to social feedback and encountering others' practice performances is that they might both relate to a more deep-rooted social-psychological tendency of people to accommodate their own actions to what they believe are the common norms and existing practices within a community. This tendency has been termed the normative social influence (Nolan et al., 2008), and it has been utilised in some feedback trials, including the often-cited American OPOWER Home Energy Report letters (Allcot, 2011). Here, the American utility company OPOWER achieved positive results with sending their customers a letter that compared their electricity use to that of their neighbours. Importantly, this included a comparison to the electricity consumption of the 20th percentile with lowest consumption, which worked as a descriptive social norm even to those with an average or slightly above average consumption. However, to the best of our knowledge, a similar approach has not yet been applied in relation to DR programmes focusing on time-shifting consumption.

Strengers (2013) points to *material feedback* as another type of practice feedback. In this context, material is used as a general term including specific technologies as well as the materiality of buildings, infrastructures etc. In the words of Hargreaves (2018), material feedback "operates through the wider material environment serving to guide the performance and evolution of practices" (p. 335). Houses are an example of a material environment, and these might be designed in ways that are often inviting to high levels of energy consumption. An example of this is the introduction of central heating and radiators with thermostats, which made it possible to heat all rooms of a house in a convenient and less laborious way compared to the heating of previous times often based on burning solid fuels in stoves, which implied that heating typically was limited to few rooms and only when people were at home. See also Shove (2003) on how habits and standards of heating/cooling homes have developed over time through an interplay with changing technologies and scientific knowledge. Combined with low energy prices, the modern home in this way "calls for" energy-intensive heating standards and practices. Both Strengers (2013) and Hargreaves (2018) point out how appliances and houses are in general built to support energy-intensive rather than energy-saving living (see also Sahakian, 2018 for other examples of how the materiality of homes shapes the standard of living and consumption).

One might argue that energy feedback solutions are designed exactly for material feedback, as this often involves hardware or software providing information to the households via mobile apps or in-home displays. The same goes for DR solutions, which also typically employ digital technologies to convey, e.g., data on variable prices (sometimes in combination with real-time consumption data of the household). However, only few everyday practices involve appliances (as material elements) that make time shifting easy or convenient. Exceptions are semi-automated machines with timers that can be used for delayed start, such as some dishwashers and washing machines. As Friis & Christensen (2016) find in relation to a Danish DR trial with static Time-of-Use pricing, households use such timers to postpone dishwashing or clothes washing to, e.g., the night hours (with low electricity prices). These timers were not originally designed with the specific aim of enabling time shifting in relation to electricity DR programmes, but the interviewed householders integrated the timers as a material element in their performance of time shifting their electricity consumption.

In relation to material feedback and DR, micro-generation represents a particularly interesting case. Several studies indicate that introducing local, micro-scale energy production in households (e.g. rooftop PVs or small wind turbines) changes the householders' relation to their own energy consumption on a more general scale. Thus, Olkkonnen et al. (2017) observe, with reference to Devine-Wright (2007), that with micro-generation, householders "live in very close proximity of their production units and take interest in how their devices operate, which changes the psychological distance and awareness of energy production from 'plug and forget' to 'in sight and mind'" (Olkkonen et al., 2017: 59-60). Several studies find evidence of households with micro-generation adopting time-shifting strategies in order to optimize the consumption of their own energy production (e.g. Olkkonen et al., 2017; Dobbyn & Thomas, 2005; Goulden et al., 2014; Kobus et al., 2015; Christensen et al., 2017). When asked, households provide various reasons for adopting these strategies, including saving money or the appeal of consuming one's own ("green") energy (see e.g. Christensen et al., 2017). In particular, the type of account settlement is decisive for whether households with micro-generation find it economically attractive to time-shift energy consumption (Christensen et al., 2017); e.g., hourly net metering account settlement schemes to a higher extent "guide" households towards DR actions than annual net metering schemes. Also, some studies find limited or no impact of micro-generation on the households' energy consumption patterns (see literature review in Bergman & Eyre, 2011), which indicates that the practice-related implications

of micro-generation are highly dependent on the wider context of socio-technical and institutional elements it is integrated within (as also argued in Christensen et al., In prep.).

The human body is, of course, an essential part of performing everyday practices (e.g. through embodied know-how), and following from this, *embodied sensory feedback* represents another initiator of cultivation and processes of learning. Royston (2014), focusing on heating practices, finds that "sensory experience is involved in negotiating and absorbing home-warming know-how…" (ibid.: 155). Examples of sensory experiences presented by Royston (2014), and which lead to changes in practices aimed at achieving higher indoor temperatures, are when feeling cold or experiencing how the butter stays hard when kept outside the refrigerator. Other examples of how sensorial experiences are closely related to householders' perception of thermal comfort, as well as to the notions of home and comfort in general, can be found in Madsen & Gram-Hanssen (2017) and Pink et al. (2013 & 2014). These examples include how the feeling of "cold tiles" on the floor can be an important marker of thermal discomfort to many as well as how the notion of what is the right thermal comfort and temperature varies with the setting and the time of the day. Regarding the latter, the importance of not feeling cold and having comfortable temperatures appear to be valued as particular important in the evening hours rather than at other times of the day, i.e. when people calm down and seek "cosiness" after a long (working) day and a high activity level around preparing the evening dinner etc. Other examples of sensory feedback related to everyday practices, but not related to heating, could be how smell and taste (along with vision) play an important role in learning how to cook food in the right way; e.g., the smell and taste of burned food prompt actions towards avoiding this in future practice performance.

Embodied sensory feedback is rarely utilized as a component in conventional DR and energy feedback solutions. However, an interesting exception is described by Pink et al. (2013), who report the findings from the UK-based project "Low Effort Energy Demand Reduction" (LEEDR). In this project, the researchers developed a digital feedback (via a mobile app) and heating control solution aimed at helping households to reduce their energy consumption by lowering their indoor temperature. The specific design of the solution was informed by findings from a qualitative study of how people "make home" (including the role of temperatures). The study was inspired by practice theories and based on theory and methods within phenomenological anthropology and sensory ethnographies. Based on the insights into how people accommodate their homes, including the daily rhythms of the families, the digital solution included an automated temperature reduction programme, which gradually reduced the indoor temperature over a long time period (several weeks) in order to make it possible for people to adapt to lower temperatures. Further, in order to take into account how people want higher temperatures in certain situations (e.g. late in the evening), the residents had the option of activating a 30 minutes "boost" of the temperature if they felt the need. Also, the digital feedback and automated control were combined with "heat me" bags, developed for the trial, which were heat-retaining pouches that could be filled with soft blankets, clothing etc. and affixed to the radiators. In this way, people could easily have a comforting experience by covering them with warm blankets and clothes if needed. In such ways, the LEEDR project invented several new and creative approaches to how energy saving measures can take into account the role of embodied, sensorial experiences. This kind of approaches might also inspire DR solutions aimed at time-shifting consumption.

A further initiator of cultivation relates to the inter-relations of the complexes and bundles of practices that make up the everyday life of individuals and households (Pantzar & Shove, 2010). Changes in one practice might therefore have implications for other practices and result in revising and re-negotiating the performance of these other practices. This is what we have termed *changes in the complex of everyday practices*. An example could be how changes in work or school schedules affect the performance and timing of other everyday practices such as bringing/picking up children from school, commuting, shopping and cooking. For instance if a parent gets a new job implying longer commuting distance and, thereby, a re-negotiation with his/her partner of the distribution and allocation of the everyday practices of the household. This thinking is also inspired by Bech-Jørgensen (1994), who talks about how changes in everyday life can be brought about by unintended consequences of unnoticed activities. It seems as three types of changes in the complex of everyday practices can initiate cultivation of other practices: adoption of new practices (for instance in relation to life-course changes, e.g. getting one's first job), discontinuation of previous practices (e.g. retiring from the labour market), and changes in performance of existing practices (e.g. change in commuting distance or getting a new heating system). Conventional DR and energy feedback do not attempt to tap into or employ this type of initiators. The challenge of solutions employing changes in the complex of everyday practices is, of course, that this often goes far beyond the individual household and relates to wider systems of practices and collective rhythms (like in the example of changing school and work hours, which could, in principal, be a way of changing the energy consumption profiles of households if people change the time of breakfast and dinner). This type of interventions

resembles the practice-based intervention type that Spurling & McMeekin describes as changing the way that practices interlock (Spurling & McMeekin, 2014).

A final type of initiator is *change in conventions and shared understandings*, which might gradually lead to changes in the way people perform certain practices. An example of this could be air conditioning allowing cooling of the interior of cars, which just a few decades ago was regarded as an unnecessary luxury and waste of energy by many (at least in temperate regions) – but is widespread nowadays. Similarly, ideas of what it means to wear clean clothes have changed remarkably throughout the years as well as our understandings of convenience and comfort more generally (Shove, 2003; Jack, 2017). Historically, these changes in conventions and shared understandings have often resulted in higher standards and increased energy consumption. Conventional DR and energy feedback do not recognize, interact with or question these conventions and shared understandings, but typically take these for granted and as part of the "user preferences". However, since time shifting of energy-consuming practices easily conflicts with established ideas of "normal" consumption and everyday life practices, it seems problematic that DR programmes refrain from engaging in the negotiations of what is normal. Interestingly, Hargreaves (2018) mentions an experimental device called the "Energy Babble", which is a radio-like sound device "that vocalizes and amplifies energy-related content drawn from the web (including Twitter and UK electricity grid updates) and combines this with voice and SMS messages inputted by (…) community members" (Wilkie et al., 2015: 84; cited in Hargreaves, 2018: 339). Hargreaves notices that in contrast to conventional forms of energy feedback "that seek to raise individuals' awareness of their own energy use, the Energy Babble tries instead to encourage its users to become more aware of and reflect on their place and role within a wide range of energy debates." (Hargreaves 2018: 339). In this way, the Energy Babble can be seen as an example of an alternative "feedback approach" (by Hargreaves seen as an example of a speculative design), which diverge from the traditional "Resource Man" conceptualization of the user (Strengers, 2013), and instead addresses the user as a knowledgeable, engaged and equal interlocutor in the discussion of sustainable energy transition and his/her personal role in this. By addressing households and the users in their role as active and engaged participants, rather than as "Resource Men", this type of feedback would represent a less "patronizing" approach compared to conventional DR and energy feedback solutions. It would be an approach resembling what Ryghaug et al. (2018) describe as "energy citizenship" created through the introduction of new technologies.

Concluding remarks

The outset of this paper was a critique of existing DR (and energy feedback) solutions for being too narrow in their approaches by conceptualizing energy consumers as "Resource Men" and by not recognizing that energy consumption is an integrated element of everyday practices, which people rarely notices or thinks about. Also, conventional DR solutions do not in general acknowledge how the performance of practices, and thereby the energy consumption patterns, is dependent on a wider context of socio-technical elements (including shared understandings, complexes of practices, materiality of the home, etc.). We sympathise with authors calling for a rethinking of DR and energy feedback approaches (e.g. Strengers, 2013; Hargreaves, 2018), and we hope that this paper contributes to the discussion of what directions such alternative paths or "speculative designs" (Hargreaves, 2018) could take. Our entry into this was the discussion of what types of "initiators" there are for processes of learning and change in everyday practices (in general and in relation to DR).

The typology of initiators in Table 1 lists a range of generic situations or dynamics that can spur processes of cultivation and learning in relation to everyday practices, and in this way represents opportunities for changing how these are performed. Strategies aimed at changing energy-consuming practices, such as DR programmes promoting active time shifting by households, could be inspired by these ways of engaging households. This contrasts with today's conventional DR approaches that in most cases focus entirely on providing (quantified) consumption information and energy system indicators to households, which leaves it up to the households to translate the abstract information into concrete action and changes in practices. We believe that broadening the scope and integrating other ways of promoting practice changes based on initiators like those identified in Table 1 could help to create more successful DR and energy feedback programmes.

However, we acknowledge that it is not an easy task to do this. We have only provided a few examples "in the passing" in this paper – and an important reason for this is, indeed, that it is difficult to come up with such creative and innovative designs. Therefore, we conclude with the following questions and suggestions that could be explored further in future DR development. These represent a few speculative and incomplete ideas on possible design solutions that might advance DR solutions further in direction of promoting cultivation, learning and practice changes:

- Could DR solutions be better at involving communities and social networks in a shared effort to realize DR on a collective level? E.g. at a neighbourhood-level? (See e.g. Burchell et al., 2016)
- Could "home parties" where people can learn about others' DR actions (e.g. local DR "frontrunners") be a way to inspire households to adopt DR practice performances? (see e.g. Burchell et al., 2015)
- Could DR programmes be combined with micro-generation in order to make the balancing issue more visible and concrete to people? For instance, by introducing national policies that support the creation of local energy communities in which people are motivated to optimize the balance between local renewable energy generation and consumption? This could be at the household, neighbourhood or city level – or within other forms of social networks, not necessarily anchored within a specific geographical locality.
- Could DR feedback be incorporated directly in appliances in homes? For instance, by making energy-intensive appliances like dishwashers and washing machines provide audio or visual cues of whether there is excess of renewable energy in the energy system or not?
- Could DR programmes tap into and employ changes in the complex of everyday practices? For instance, when people move to a new home and, as part of this, renegotiate many of their daily practices and the temporality of these?
- Could DR programmes make room for discussions of (or deliberately challenge) established conventions and shared understandings of how practices are performed and the standard of living? Perhaps as a discussion among a physical-local or virtual community of people?

The above ideas are only a first attempt of "creative thinking" on how the identified cultivation and learning initiators might be translated into new DR designs. We hope this paper can inspire researchers, DR designers and policy-makers to further innovation within this area.

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