TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Of chalk and cheese

Citation for published version (APA):
Kuijer, L., & Bakker, C. (2015). Of chalk and cheese: behaviour change and practice theory in sustainable design. *International Journal of Sustainable Engineering*, *8*(3), 219-230. https://doi.org/10.1080/19397038.2015.1011729

DOI:
10.1080/19397038.2015.1011729

Document status and date:
Published: 04/05/2015

Document Version:
Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy
If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

Download date: 27. Oct. 2021

Of chalk and cheese: behaviour change and practice theory in sustainable design

Lenneke Kuijer[a] and Conny Bakker[b]

[a]*Department of Industrial Design, Delft University of Technology, Delft, The Netherlands*

[b]*Department of Design Engineering, Delft University of Technology, Delft, The Netherlands*

Abstract

Design for Sustainable Behaviour (DfSB) is becoming increasingly influential in the areas of design research and practice. With its success however, concerns are also rising about its limitations. This paper bundles these concerns and illustrates how DfSB approaches tend to focus on incremental savings that disappear in larger trends, how it risks not achieving the intended behaviour change, how its literature contains a strong rhetoric of right and wrong behaviours and how opportunities for larger scales of change tend to be missed. These concerns are illustrated using examples from the DfSB literature concerning refrigerators, electric kettles, televisions and showers. Going deeper into these limitations, the paper argues that the assumptions underlying DfSB approaches concerning the nature of behaviour and its relation to product design contain a focus on individual behaviour change that may not be the most appropriate basis for approaching the complex issue of sustainable consumption. Building on a growing number of publications in environmental policy and sustainable design, the paper then moves to explain practice theory as an alternative paradigm and argues that it can aid designers to envision change beyond the status quo and to achieve a higher effectiveness with designed interventions.

Keywords: design for sustainable behaviour; household energy consumption; practice-oriented design; social practice theory

1 Introduction

As indicated in the call for papers for this special issue, ‘Design for Sustainable Behaviour’ is an emerging area of research and practice in design. In the past years, publications on the topic have quickly grown and products developed based on its recommendations are now available in the market. However, with its success, concerns for its limitations in reaching the objective of reduced levels of household resource consumption have also risen. These concerns partly originate from and show strong similarities with ongoing debates in the related area of environmental policy. In policy oriented research, similar efforts aiming to ‘motivate people to behave more sustainably’ through policy measures exist (e.g. Stern 2000, Darnton 2004, Jackson 2005). Critics of these approaches argue that the focus on individual behaviour change they adopt is limiting. They propose practice theory – a group of theories from sociology – as a promising alternative basis for environmental policy development (Røpke 2009, Shove 2010, Spaargaren 2011, Gram-Hansen 2011, Hargreaves 2011, Doyle and Davies 2012). Recently, this idea of focusing on practices instead of behaviours has spread to the area of sustainable design. This paper reflects what such a focus could mean for sustainable design research.

Drawing on literature in the areas of policy and design, the main objective of this paper is to argue why practice theory enables an interesting point of view for sustainable design. It will do so by arguing how limitations of current approaches, as represented in existing literature can be traced back to the paradigm of individual behaviour change, to which practice theory forms an alternative. The argument will be illustrated by four examples from the Design for Sustainable Behaviour and Persuasive Technology Design literature concerning refrigerators, electric kettles, televisions and showers. Moreover, following Shove (2010), the paper will argue how the behaviour and practice paradigm are like chalk and cheese in the sense that they form fundamentally different ways of approaching issues of sustainable consumption.

Because methods in design for sustainable behaviour literature focus on the interaction between a product and its users, they are in this paper referred to as interaction-oriented approaches to sustainable design.

2 Interaction-oriented approaches to sustainable design

Literature on interaction-oriented sustainable design has focused on identifying, developing and ordering design strategies and applying these strategies in, mostly fictive, design cases. After briefly summarizing the interaction-oriented approaches proposed in design literature, this section will present four interaction-oriented illustrative examples taken from this body of literature, which are in the next section used to illustrate the points of concern raised by different authors commenting on these approaches.

Elias (2007), Lockton et al. (2008), Wever et al. (2008), Lilley et al. (2009) and Zachrisson and Boks (2012) all present similar orderings of design strategies for developing products that ‘may stimulate desired behavioural patterns or help avoiding undesired ones’ (Zachrisson and Boks 2012). The goal of these approaches is ‘designing products in such a way that unsustainable behaviour is made difficult or impossible, while sustainable behaviour is made easy or easier, or even automatic’ (Wever et al. 2008). Implicitly, three types of potential users are distinguished in these strategies.

The first type is users who already want to change their behaviour towards a ‘good’, already known form and technology is designed to help them in that pursuit. Zachrisson and Boks call them ‘positive users’ which are ‘users that are willing to make an effort to behave sustainably’ (Zachrisson and Boks 2012), and Lockton describes the aim of these strategies as ‘making it easier for users to be more efficient’ (Lockton 2008). The second type is users who do not yet have such good intentions. For these people, the design is there to persuade them to ‘take responsibility’. For example, Bhamra et al. explain that ‘[p]roviding consumers with options through product and system or service design could encourage them to think about their use behaviour and take responsibility for their actions.’ (2011: 431). Persuasive technologies focus on this type of users. A third type is users who cannot be convinced to change their behaviour voluntarily. While ‘consumers should be given the choice to behave in the ‘right’ way: only if they failed to do so should the product take action to prevent their behaviour’ (Bhamra et al. 2011: 440). These strategies allow ‘inefficient’ operating procedures to be prevented (Lockton 2008) without requiring cooperation or even acknowledgement from the user. For example, automatic lighting and water taps that only operate when a user is present. The responsibility for turning off the device after use is then delegated (using the term of Latour (1992)) to the technology.

In line with these three possible types of users (willing but helpless user, ignorant user, or disobedient user), the widely cited redesign strategies proposed by Lilley (2009) range from merely informing people about

what is ‘good’ and what is ‘bad’ behaviour, via helping people to quit the ‘bad’ and perform the ‘good’ behaviour, to ‘automatically controlling’ the user to perform the ‘good’ behaviour. Similar in all approaches is that an existing device is selected, analysed and redesigned using one or more of the proposed design strategies. In this process, analysis of the selected product and its ways of use guide the choice for a certain design strategy. For example, a consumer study shows ‘fridge use behaviours’ to be mainly habitual, Tang and Bhamra (2012) select the ‘eco-spur’ and ‘eco-steer’ strategies to address them. The question central to this literature is ‘how products can be designed to achieve sustainable behaviour’ (Zachrisson and Boks 2012), which is reflected in the emphasis on developing strategies and ways of selecting them.

To offer some more body to this theoretical explanation and to illustrate points of critique in the next section, four examples from the interaction-oriented sustainable design literature will be briefly explained. They focus on the refrigerator, the electric kettle, the television and the shower. These particular examples were selected because they occurred in several publications. Elias is cited frequently because he is one of the few authors who specifies and quantifies the ‘sustainable’ and ‘unsustainable’ behaviours so central in the strategies and the refrigerator example is somewhat more elaborate because it explains in detail how these behaviours were defined.

2.1 Four illustrative examples of interaction-oriented design cases

The *refrigerator* is used as an example in Elias (2009), Bhamra et al. (2011), and Tang and Bhamra (2012). As mentioned before, the fridge has been identified as a product with a large environmental impact during its use phase, not in the least because it is on 24/7. After studying fridge use in context, all three papers select the time the fridge door is opened as the focal ‘most damaging behaviours’ (Tang and Bhamra 2012) to be addressed by a redesign of the fridge. For calculating potential savings, Elias uses a ‘typical’ domestic 200 litre refrigerator that was measured to use 250kWh per year when in use. He then determines the user-related losses – being ‘the amount of energy that has been used over and above the optimal use of a product’ (Elias 2009). Based on observational the studies of actual fridge use, Elias defines the optimal way of using the refrigerator as opening it 24 times a day for 5 seconds. Any difference between this optimum and the actual use is designated as ‘inefficient actions of the user’, something he elsewhere refers to as ‘bad behaviour’. To calculate potential user-related savings, Elias presents different use scenarios based on empirical data. In one of these scenarios, a family opens their fridge door 42 times per day, of which 6 times for extended durations (more than 3 minutes). If this family would, as a result of an interaction-oriented redesign, reduce this to the calculated optimum, the potential of 27%, or 90kWh per year of savings could be achieved. Proposals for redesigns include a beep sounding after the door has been open for ‘too long’ (Elias 2009), a rearrangement of the interior to ‘lock the location of the food so that the user always knows where to find it’, a system to see what is in the fridge without opening the door (Bhamra et al 2011), and a ‘breakfast box’, being ‘a compact unit offering easy access to the most common items’ (Tang and Bhamra 2012).

The *electric kettle* is referred to by Lockton (2008) and Elias (2009). Main use behaviour problem identified in relation to this appliance is that people boil more water than they need. For example, Elias refers to an Australian study (Remmen and Munster 2003), which found that 15% of the electricity consumption related to electric kettle use is ‘unnecessary’, something later specified as ‘water that is boiled but not immediately used’. Re-design proposals include only heating water that is poured out, as for example in the Quooker, or a

kettle with additional reservoir that stimulates precise dosing of the number of cups, as in the Eco Kettle. An independent study by the UK Energy Saving Trust has shown that use of the Eco Kettle can result in 30% reductions in energy consumption (EST 2006).

The *television* features in Wever et al. (2008) and again in Elias (2009). The focal behaviour related issue identified by both authors is the situation where the television is on but not being used 'in any beneficial sense' (e.g. because no-one is there or they are asleep). The design intervention proposed is introducing a blind mode that either can be activated through the remote control, or will activate automatically when the 'smart' TV senses a situation where nobody is watching. Potential savings are calculated by taking the baseline scenario of watching 3,6 hours of television per day, which refers to the average television consumption per household in the UK at the time of the study (Elias 2009).

Finally, the *shower* is the topic in Laschke et al. (2011), Ravandi et al. (2009) and Kappel and Grechenig (2009). In all three studies, targets were to reduce shower durations through different forms of persuasive technologies, all involving feedback in combination with some kind of reward or motivating mechanism. For Laschke et al. this mechanism is a shower calendar with dots that shrink in response to water used beyond 4 litres, up to a maximum of 60 litres. For Ravandi, it is a game where creatures can be earned when self-set targets are met (they give an example where anything below 160 litres per day is a reduction), and for Kappel and Grechenig it is a cord with eight led lights that light up in sequence after every 5 litres, up to a total of 80 litres. Field tests by Kappel and Grechenig are most explicit about the savings obtained; they report reductions from an average of 45 litres per shower to 35 litres per shower over three weeks. Ravandi et al. have not done actual tests but show a fictive simulation in which savings add up to as little as 0,08 litres per person per day, as compared to an implicit benchmark.

3 Limitations of interaction-oriented approaches

From the above examples it becomes clear that interaction-oriented approaches are relatively straightforward to implement; for all products some form of redesign or additional device implementing the suggested strategies is available in the market today; refrigerators with beeps, one-cup kettles, blind mode buttons and shower timers are all for sale. The design problem is presented relatively orderly and the metric of change (e.g. reduced fridge opening time) is convenient to handle and measure. This contributes to a relatively short time to market of this type of interventions. For some situations, as for example shown in Kappel and Grechenig (2009) and the case of the Eco Kettle reductions can be achieved. However, not disregarding these strong points, a variety of concerns relating to interaction-oriented approaches has been raised as well. Here, they are summarized into four related points of concern that are illustrated using the examples introduced in the previous section. The points of concern are a focus on incremental savings that tend to disappear in larger trends, a risk of failing to achieve the intended behaviour change, a strong rhetoric of right and wrong behaviours and a risk to miss opportunities on larger scales of change.

3.1 Incremental savings tend to disappear in larger trends

Interaction-oriented approaches, Scott et al. (2011) argue, are limited because they focus on specific products, user types and moments in time. Similarly, Brynjársdottir et al. (2012) find that framing sustainability as the optimization of simple, measurable metrics, although enabling 'a wide range of technical solutions', these solutions 'tend to break down in the face of ecological issues outside of the "selective reality" constructed through the problem framing' (Brynjársdottir et al. 2012: 951). As can be illustrated using the examples introduced above, this strategy of simplification to reductions of single metrics of specific interactions runs the risk of rendering incremental savings at most that tend to disappear in on-going trends in product development and use behaviour.

In case of the *fridge*, for example, a clear trend can be observed of increased volumes of refrigeration per household. According to a study by the Energy Saving Trust, penetration rates of fridges in the UK increased from 58% to 107% between 1970 and 2003. Different from Elias' 250 kWh benchmark, this same report defines a 339 kWh fridge as 'normal' and identifies a trend in the growing popularity of the large size American fridge that uses 500kWh per year (EST 2006). The 90kWh potential savings are in this case strongly reduced or nullified by trends in increased volumes of what is refrigerated. Moreover, larger fridge sizes are likely to result in longer door opening times, simply because more stuff needs to be taken out that is more difficult to find.

A similar analysis can be made of *electric kettles*. Eco Kettle © is mentioned as a product with 30% potential savings compared to a 'standard kettle', but in the same report, keep-warm kettles, identified as a potential new trend in kettle design, were calculated to potentially increase energy use by 46% in the same study (EST 2006).

In *televisions*, 'normal' size has rapidly increased with the introduction of the flat screen. Where Elias (2007) takes a 32" television as a benchmark, a quick round amongst colleagues and web shops in the fall of 2012 indicates that a 32" is by then considered small, and 36" now fulfils this, probably temporal role of being the standard screen size[*]. Moreover, time-use studies indicate that average hours of television consumption per day show a strong rise in the past years. Vergeer et al. (2008) identify an increase from 100 minutes in 1980, to over 180 minutes in 2002. In the UK, average television watching time per household was 3,6 hours in 2007, 4,8 hours in 2009, over 6 hours in 2012. In addition, penetration rates have now increased to well above 100% - 98% of households own at least one TV, with average on 2,3 sets per household, a rate predicted to grow (Owen 2012).

Finally, in *showering*, a Dutch study by Foekema and Van Thiel (2010) finds a relatively constant shower duration of around 8 minutes, but increasing showering frequencies and shower head flows, from 7,7 for regular showerheads to 14,4 litres per minute for the increasingly popular 'comfort shower'. Over the past years, water use for showering has thus increased by 25%.

In sum, a focus on product-user interaction tends to isolate specific situations and metrics and thereby runs the risk of disappearing in larger trends. In addition, the European Environment Agency does not only ascribe disappointing effects of energy efficiency efforts to increased use of appliances, it also points to the

[*] And indeed, another round of web shops in the summer of 2013 shows 36" to have moved to the 'small' category as well, and 'middle' screen size to be around 45"

increasing number of appliances overall (EEA 2005). According to MileuCentraal (2010), major[†] contributors to the household energy bill are dishwashers, computers and dryers; all products that did not widely exist twenty years ago. This means that even when taking into account larger trends, it is limiting to look at individual appliances alone. Additionally, as the next section will argue, achieving the intended behaviour is certainly not ensured by following the proposed design strategies.

3.2 Intended behaviour change may not be achieved

Because interaction-oriented approaches tend to assume rather specific use scenarios that are optimized on a particular dimension by the proposed re-design, there is a risk that actual use situations will not reflect these specific scenarios. Not in the least because the redesign itself changes the 'base case' scenario in ways beyond the specific intended behaviour change (Akrich 1992, Oudshoorn and Pinch 2007). In such cases, desired effects may not be achieved, or, as some argue, even countered. Users may resist the predefined use scenario by simply ignoring it or even sabotaging the particular function (Verbeek and Slob 2006, Brynjársdottir et al. 2012). In other situations, specific use scenarios even contribute to increases in resource consumption; because they tend to assume the current status quo, redesigns run the risk of confirming undesirable standards or even setting higher ones (Pierce et al. 2010, Strengers 2011).

With regard to the beeping *refrigerators*, a quick search online reveals forum messages with titles like 'how to turn off the beeping'. Ehow.com offers methods to stop the beeping sound of a particular fridge brand with the observation that 'many users find it annoying'. What is also interesting to note is that this same refrigerator beeps after the door is open for more than 60 seconds. Rather than reducing fridge door opening times, such a function may confirm that anything up to 60 seconds is good or allowed, possibly having an opposite effect on energy consumption. Moreover, an 'optimal arrangement' of the fridge contents or 'locking the location of food items' or accommodating for the 'most common items' may make it easier to find things in some specific situations, but is likely to be inappropriate for any scenario diverting from this specific situation. Clearly eating habits and ways of using fridges are highly varied (De Jong and Mazé 2010).

In case of the *electric kettle*, Elias himself expresses concern about potential counter effects. The almost instant availability of boiling water in for example the Quooker™ could 'result in a much greater usage of boiled water than would have previously been required, the rebound effects of this product would therefore be large, negating any energy saving and in fact increasing it beyond previous levels' (Elias 2009).

In case of automatic detection of viewers by *television* sets, errors may be made, leading to irritation. For example, automatic standby functions exist on some televisions, but they use interaction with the remote control as an indicator for presence (e.g. Sony), which is not really accurate in case of for example watching a long movie. Moreover, a blind mode may reduce energy consumption in scenarios where the television was left on just for the sound, but it also communicates this type of use as normal, while listening to the radio might be a more energy efficient way of providing the same service.

In the *shower* examples, the feedback device designed by Ravandi et al. (2009) explicitly assumes daily showers, while showering isn't necessarily a daily affair (yet). Average shower frequencies in the Netherlands

[†] Other large electricity consumers in the home are: whirlpool, tropical aquarium, electrical boiler, waterbed, garden pond with pump, air conditioning, sauna (infrared), plasma screen(s), terrace heater, steam cabin, second fridge/freezer, massage chair and electrical heating.

are 5-6 times per week (Foekema and Van Thiel 2011). Moreover, such a device necessarily sets a standard for 'normal' shower durations that may be higher than current routines of part of the potential users; the 160 litres example taken by Ravandi et al. is more than twice the Dutch daily average.

Because interaction-oriented strategies assume certain specific and partial use scenarios to be representative for the wide range of ways in which the re-design will be used, there is a risk of scenarios not corresponding to actual use situations. Next to irritations and frustrations, such situations may lead to nullification of intended results, but also to opposite effects of those aimed for. Moreover, as the next section will argue, there is another concern related to these specific use scenarios.

3.3 Strong rhetoric of right and wrong behaviours

Besides the question of whether or not intended reductions in household resource consumption can be achieved, several authors show a concern with the strong rhetoric of 'right' and 'wrong' behaviours that is present in interaction-oriented sustainable design literature. For example, Elias poses that '[t]he use of a product will inevitably include a range of good and bad behaviours, with good behaviour being more energy efficient than bad' (Elias 2009). Brynjársdottir et al. (2012) find that this simplification of 'good' versus 'bad' behaviours places technologies as 'seemingly objective arbiters over complex issues of sustainability'. Relatively little attention is paid to defining what these good or sustainable behaviours actually are, seemingly because they are considered evident. This is reflected in for example Blevis' statement that

> 'It is easier to state the kinds of behaviours we would like to achieve from the perspective of sustainability than it is to account for how such behaviours may be adequately motivated.' (Blevis 2007: 508)

Defining what is 'good' or 'bad' behaviour is places the designers of the technology in an unjustified position of authority over other people's lives when these normative ideas are embodied in technologies 'which will judge users' behaviour along the expert's lines' (Brynjársdottir et al. 2012).

According to Elias, 'unsustainable' behaviours occur when 'the product is misused, used unnecessarily or excessively' and in such cases using the product 'will waste energy' (Elias 2009). For example, a fridge door that is opened 'too often' (more than 24 times a day) or kept open 'too long' (more than 5 seconds). In such a view, a birthday party, or a child helping to fetch the milk may easily constitute 'bad behaviour'. Similarly, Tang and Bhamra (2012) explain that their consumer study revealed that usage patterns of household cold appliances resulted in 'unnecessary energy consumption'. In Laschke et al. (2011), the rhetoric of 'unsustainable' behaviours gets even stronger, when 'bad' habits, such as for example 'long' showers are equated with alcoholism, smoking, drug and gambling addictions by citing Rachlin (2009).

Mirroring this idea of 'unnecessary' consumption is the idea of 'necessary' consumption, which 'fulfils people's (actual) needs' (Bhamra et al. 2011). What is necessary consumption is determined from observing examples of people's current behaviour and looking at statistics on average consumption patterns. For example, in Elias (2009), opening the fridge 24 times for 5 seconds is the 'base case' or 'optimum behaviour' that was determined from observational studies and the normal duration of watching 3,6 hours of television per day is based on the then counting UK average. Alternatively, in Laschke et al. (2011) a 'free' amount of four litres of

water was determined by one of the authors. For this person, it turned out to be at minimum required to ‘achieve a comfortable feeling of cleanliness’ with a shower. Clearly, this is a very situated result. For the comfort showers described by Foekema and Van Thiel (2011) for example, four litres translates into a showering duration of 17 seconds. Besides being unilaterally determined by the designer, these ‘good’ behaviours remain unquestioned. For example, in case of the television, rendering the time it is watched as beneficial ignores studies that show that benefits of watching television may be minor, while undesirable effects have also been identified, especially amongst children, such as obesity, and behavioural and (language) development problems (e.g. Christakis et al. 2009, UK National Literacy Trust 2013).

Summing up, the particular use scenarios aimed for in interaction-oriented sustainable design contain rather narrowly defined ideas on what is considered necessary and unnecessary energy consumption. Moreover, which forms of behaviour fit in one or the other category is determined by the designer, who uses existing, particular or average use situations without questioning their representativeness or desirability. Thus, the ‘need’ for the services these devices offer is taken for granted (Scott et al. 2011). This limits the scope of change aimed for. For example, when calculating the theoretical minimum value and defining the targeted ‘sustainable behaviour’ of a certain device, Elias explains that ‘essential product features or functions must be kept constant’. In case of a tumble dryer, line drying can therefore not be taken into account, since it ‘shares none of the convenience or speed of the tumble dryer’ (Elias 2009). Questions of why refrigeration, hot water, watching television, showering or clothes drying are needed at all, and how much of it are not addressed or only sideways. Consequently, clearly less resource intensive options, like line drying, are excluded as a form of ‘sustainable behaviour’, because the ‘need’ for convenience and speed in clothes drying is assumed. Similarly, focusing on fridge door opening times diverts attention from questions on the growing role of refrigeration in today’s Western food systems (Shove and Southerton 2000).

What is good or bad behaviour is something that is understood and clear in the minds of the designers, so much so that it often does not need explicit discussion. All the while, questions of what ‘sustainable behaviour’ is, who determines it and whether it can be ensured or ‘designed’ at all, are left unaddressed. These more fundamental questions open up complex discussions on what products are actually about and would, as critics argue, be more appropriate questions when addressing an issue as complex and intertwined with daily life as household resource consumption. Moreover, by following making these assumptions, important opportunities for change are missed.

3.4 Opportunities for larger scales of change are missed

A fourth and final critique that touches on the core of these approaches is that they delegate responsibility for the reduction of society’s resource consumption to individuals – whether designers or users. Critics argue that within given cultural, social and material surroundings, the changes that can be made on an individual level only go so far (Scott 2009, Shove 2010). Not only does this focus divert attention away from other agents of change, it also tends to result in investments in relatively small reductions (if reductions are achieved at all).

In case of the refrigerator for example, the role of the kitchen industry in fuelling larger fridge sizes, the role of the food industry in introducing more products to be refrigerated, the role of EU or national regulations surrounding best before dates, or the role of cooking books in assuming the availability of a refrigerator, are not taken into account. Nevertheless, they all eventually play a role in the resources consumed for refrigeration in

households. Inversely, choosing a smaller fridge that does not fit a household's kitchen design and eating habits, or extending best-before dates is not something that individuals can simply do by themselves. Because many of these changes lie beyond the playing field of the individual, they tend to be ignored in existing interaction-oriented approaches, or, as Brynjarsdottir et al. (2012) state interaction-oriented approaches 'tend to neglect the need for change at other scales beyond the individual consumer'. This poses the risk of making unsustainable levels of resource consumption a problem of the consumer, while other institutions clearly implicated in the issue can simply continue with business as usual.

While on the one hand, design is viewed as a means to 'solve environmental problems of use behaviour' (Bhamra et al. 2011) and (persuasive) technologies, particularly when they operate ubiquitously and automatically, as having potential 'to be incredibly effective' in 'ensuring more sustainable behaviour' (Lilley 2009), the kinds of behaviours considered to lie within the sphere of influence of the designer are taken quite narrowly. Tang and Bhamra (2012) for example, present data on potential savings relating to fridge use, distinguishing between the areas of door openings, inserting warm items, operating temperature and surrounding temperature. From this data, it becomes clear that door openings account for between 1 and 17% of the fridges yearly energy consumption. They do not specify how much they think this can be reduced, but obviously not opening the fridge at all is not an option, at least in their views. Interestingly, they quote a research that found that keeping a cold appliance in a non-heated storeroom rather than a kitchen gave an average energy saving of 36% (Tang and Bhamra 2012). Yet, they do not explore this potential at all in their design proposals, presumably because they consider the location of the fridge to lie outside of the product-user interaction realm.

In brief, focusing on interactions tends to limit the change that is aimed for to (small) changes within the status quo. Something that is, as Manzini nicely phrases it, not sufficient to address the challenges faced by society:

> 'increasing improvements in the existent are not enough: the transition towards sustainability requires a systemic change. It is not a question of doing what we already do better, but of doing different things in completely different ways' (Manzini 2009).

4 Underlying assumptions of interaction-oriented approaches

Before going deeper into approaches to sustainable design that could work towards 'doing different things in completely different ways', this section first makes an analysis of why interaction-oriented approaches tend to focus on 'incremental improvements to the existent' and risk not achieving desired change or even opposite effects. In agreement with Brynjársdottir et al. (2012), Dourish (2010) and Strengers (2011), we believe that limitations of interaction-oriented approaches to sustainable design are not isolated problems. Rather, these limitations can be traced back to the basic assumptions about human behaviour underlying them. As will be argued below, these assumptions have consequences for ideas about how behaviour can change and about the role of products and designers in these changes. Analysing these assumptions not only highlights that interaction-oriented approaches draw on a particular way of conceptualising human behaviour, but also that alternative ways of approaching the issue of sustainable consumption exist.

Papers in the Design for Sustainable Behaviour field are quite explicit about their theoretical origins. Based on the shared idea that '[e]nvironmentally relevant behaviour lies at the end of a long causal chain involving a variety of personal and contextual factors' (Stern 2000, quoted in Zachrisson and Boks 2012), researchers draw on theory from (environmental) psychology and social-psychology. These fields, in turn use and develop models and theories like the 'theory of interpersonal behaviour' (Triandis 1984), the 'theory of planned behaviour' (Ajzen 1991), 'attitude-behaviour-context theory' (Stern 2000), or the 'comprehensive action determination model' (Klöckner and Blöbaum 2010) to 'understand, explain and change human behaviour' (Klöckner and Blöbaum 2010). The models use a varying number of factors like attitudes, norms, habits and context and propose different ways of relating these. In these factors, a distinction is made between internal factors such as personal norms, attitudes, beliefs and habits and external factors, such as social norms, incentives, context and situation (Jackson 2005). Several authors pay specific attention to habits (Triandis 1984, Verplanken and Wood 2008) and distinguish between intentional and habitual behaviour. Habits are forms of 'automated' behaviour that is performed 'unconsciously' and in automatic response to environmental cues, but were once formed based on intentional decisions. However, '[a]s people repeat actions, their decision making recedes, and the actions come to be cued by the environment' (Verplanken and Wood 2008). This scale, ranging from intentional to habitual, returns in the categorisation of design strategies used in the interaction-oriented literature.

What all models have in common is a focus on individual behaviours and viewing these as outcomes of a series of related factors. Looking at social theory, this theoretical stance can be positioned in a larger frame. Social theorist Reckwitz (2002) distinguishes three forms of conceptualising human behaviour and the way it is organized being: purpose-oriented theories, norm-oriented theories and cultural theories. The models lying at the basis of interaction-oriented approaches all fall within the category of purpose-oriented theories. In these theories, behaviour is explained in terms of individual purposes, intentions and interests and social organization as a product of the combination of single interests. Some theories seem to combine this view with what Reckwitz calls norm-oriented theory in which focus is on normative consensus and social rules, or what Jackson (2005) calls 'social and institutional contexts'. In Jackson's view, however, these normative structures merely form a 'social context within which people act'. Essentially, the behavioural model thus advocated is in line with the psychological models described above, which centralize individual behaviour as the focal unit of analysis and change.

In brief, interaction-oriented approaches draw on theories in which individual behaviour is taken as the focal unit of analysis and change. This focus on individual behaviour, combined with ideas of behaviours as the result of a predictable process, we argue, lies at the basis of the limitations brought forward in Section 3. A focus on individuals as autonomous decision makers results in a scope of change lying within the limited changes individuals are considered to be willing and able to make, while viewing behaviour as predictable assumes a certain uniformity of behaviour in relation to which particular, optimized scenarios make sense. This predictability of behaviour based on causal models, in addition, places a great faith in technology's (or any intervention's) ability to 'ensure sustainable behaviour' to happen, and the supposed uniformity of behaviour rhymes with the rather strict categories of good and bad behaviour.

As illustrated by its positioning within social theory, purpose-oriented approaches such as the above mentioned behaviour change models are not the only possible way of conceptualising human behaviour. A particular alternative, categorized by Reckwitz as a form of cultural theory, is social practice theory. Both in the

policy and design research area, this alternative is increasingly explored in relation to issues of sustainable consumption. The following section will argue why practice theory could form a promising alternative to the purpose-oriented, individual behaviour focused theories now drawn on in sustainable design.

Before going into practice theory however, it has to be noted that the purpose-oriented theoretical position taken in sustainable design is not surprising. The paradigm of individual behaviour change is mainstream not only in sustainable design, but in its surrounding fields of environmental policy and design research in general. Shove (2010) highlights the dominance of individual behaviour change by quoting several governmental report titles that show a clear rhetoric reflecting this paradigm, such as 'Creatures of habit: the art of behavioural change' (Prendergast et al. 2008); 'Changing Behaviour Through Policy Making' (DEFRA 2005) and 'Motivating sustainable consumption' (Jackson 2005). In design research, this position manifest for example in the popularity and quick spread[‡] of design-oriented concepts like persuasive technology (Fogg 2002) and nudging (Thaler and Sunstein 2008), which lie beyond sustainable design, but contain the same rhetoric of individual behaviour change. Moreover, the focus on individual behaviour is directly compatible with ideas of user-centred design (Norman 1986), which have become wide spread in design research, education and professional practice over the last decade.

5 An alternative paradigm and its potential for sustainable design

Besides commenting on interaction-oriented strategies, several authors have proposed alternative approaches for sustainable design that address these limitations. A recurring element in these alternatives is an expansion of the fundamental unit of analysis from product-user interactions to something broader. A subsection of authors suggests socially shared practices as a candidate for such an expansion. Taking practices instead of interactions as a unit of analysis is argued to help understand 'the dynamic relation between things and those who use them' (Shove et al. 2007), help think beyond the individual (Julier 2007), address complex issues of consumption (Munnecke 2009), take into account the dynamics at play in everyday consumption (Pettersen 2009), consider energy consumption in the context of broader sociocultural practices (Brynjársdottir 2012), highlight 'the dynamics within and between households, the practices consumption is implicated in, and shifting expectations of normality' (Strengers 2011), provide opportunities for sustainable living (Hielscher et al. 2008), and offer 'a more systemic approach that can help design for sustainability efforts to grapple with the uncertainties of consumption, such as rebound effects and user acceptance issues' (Scott et al. 2009). According to these authors, practice theory is interesting for sustainable design. But what is it and what makes it so interesting?

5.1 Practice theory

Practice theory represents a way of understanding society that takes practices as the fundamental and smallest unit of social analysis. In the words of Reckwitz, practice theory, like other versions of social and cultural theory offers a conceptual framework that comprises a certain way of seeing and analysing social phenomena, which enables certain empirical statements, and excludes others (2002). Although not using the same terms or going as far as Reckwitz, all practice theorists emphasize the positioning of practice theory as a middle ground between

[‡] cited in googlescholar over 1700 and 2700 times respectively (accessed 16 August 2013)

opposing dichotomies. This middle ground positioning is highlighted because it is important for how practice theory is understood. While containing recognizable elements for researchers in both sides of the scale, practice theory is fundamentally different. Schatzki explains this position as follows:

> In practice theory […] accounts all undermine the traditional individual-nonindividual divide by availing themselves of features of both sides. […] it appropriates in transfigured form a variety of individualist *explanantia*, while grounding these in a supraindividual phenomenon' (Schatzki 2001:5)

In other words, taking a practice theoretical approach does not mean that individuals or norm structures are ignored, rather the contrary. However, individual behaviour is not viewed as explanatory of structures and structures not as capable of explaining individual behaviour, neither is the field of practices explanatory for either. In fact, practice theorists, Schatzki poses, are 'suspicious of "theories" that deliver general *explanations* of why social life is as it is' (Schatzki 2001: 4 emphasis in original). Rather, practice theory offers a conceptual framework to give a 'general and abstract account' (Schatzki 2001:4) of the topic of study and as such, gain understanding of that particular topic.

5.2 Practice theory's potential for sustainable design

In the paper 'Beyond the ABC: climate change policy and theories of social change' that has strongly inspired this one, Shove (2010) contrasts individual behaviour and practice-oriented perspectives in environmental policy research. According to Shove, a major limitation of the behaviour change perspective is the blind spot it creates, by conceptualising desires and attitudes as drivers of behaviour, for the way in which these desires and attitudes come to be as they are. By taking 'needs' as external to the actual behaviour, they are treated as fixed leading to a limitation of what is seen as feasible to change *within* these existing frames of reference. In other words, behaviour change approaches 'fail to capture vital processes of social change' (Shove 2010). By centralizing practices and placing people in a 'secondary role' as carriers of practices, Shove continues, interest shifts towards how more or less resource intensive practices emerge, circulate, persist and transform (Shove 2010). Because in practice theory needs, desires and attitudes are seen as an integral part of practices (and not as properties of individuals), they too are subject to change. As such, the status quo is questioned and possibilities for radical change come into view. However, at the same time a practice-oriented view acknowledges that changes of this type are 'not processes over which any one set of actors has control' (Shove 2010).

Following Shove's argument for environmental policy, practice theory implies forms of design that are both more ambitious and more modest than those working from a behaviour change perspective. More ambitious because the sphere of influence of the designer is expanded from working within to working with the status quo, and more modest because the agency of the designer to singlehandedly steer or shape behaviour is put into perspective. In addition, we argue that design approaches that take a practice theoretic perspective not only shift attention to a larger scale of change, but also have a higher chance of achieving changes than behaviour oriented approaches.

To substantiate this point, a little more background on practice theory is necessary. In practice theory, a distinction is made between practices-as-entity and practices-as-performance (Shove et al. 2007, after Schatzki 2001). The practice-as-entity refers to the practice as a constellation of elements – grouped by Shove et al.

(2007) as images, skills and stuff or meanings, competencies and artefacts – that endures over space and time. The practice-as-performance, the moment of doing in which the elements are integrated by people in specific situations, is slightly different each time, because practices are 'internally differentiated on many dimensions' (Warde 2005: 138). In these terms, change in the practice-as-entity is seen as resulting from everyday instances of adaptation, improvisation and experimentation (Warde 2005) in performance. These situations can be triggered by the introduction of a new product, but the way in which the elements reconfigure in response to such an intervention only emerges from performance and is therefore inherently unpredictable. Moreover, the effects of an intervention, in line with the high variety in performances, will never be uniform.

These central concepts of emergence and diversity that follow from a practice-oriented outlook on change are fundamentally different from the view on change inherent in an individual behaviour change paradigm that assumes predictability and uniformity, as argued earlier. What this outlook implies for design approaches needs further exploration, but examples that currently exist in literature indicate a shift of the locus of designing towards everyday life settings (Scott et al. 2011, Kuijer and De Jong 2012), and an emphasis on open forms of design that allow for a diversity of use scenarios (Kuijer et al. 2013). When '[d]esiging change by living change', as Scott et al. (2011) propose, all forms of design are viewed as participatory in the sense that people creatively reconfigure practices in everyday performance. In such a view, practice-oriented design leads to a deeper understanding of the complex and emergent implications of an intervention on daily life. It thus allows for exploitation of desirable and partial anticipation of undesirable effects of interventions, leading to a higher chance of success in achieving the desired change in practice. Moreover, while the pursuit for optimization prevalent in interaction-oriented approaches risks excluding use scenarios that deviate from the expected one ('to fit means to fit something at the expense of something else' (Redström 2006)), an open design is more appropriate for the wide variety of use scenarios it will inevitably end up in.

Finally, in addition to potentially being more effective in reaching the objectives of reduced household resource consumption, we also argue that a practice-oriented approach to sustainable design can shift or even render obsolete ethical concerns related to designer's efforts to intervene in daily life. This point relates directly to the more modest role assigned to the designer in a practice-oriented view. In practice-oriented design, the designer is seen as a facilitator or catalyser of change in practice that is eventually a concerted, emergent achievement of a variety of stakeholders. If the designer is not viewed as the one determining ways of interaction between users and products, the responsibility of the designer for the outcomes and effects of design decisions also reduces. Moreover, while practice-oriented sustainable design is still normative in the sense that lower resource intensive ways of life are seen as more desirable than current ones, the rhetoric used is not one of good and bad behaviour. Rather, practice-oriented design is normative about levels of resource consumption, but much less determinant in ways of achieving such reductions, i.e. the 'sustainable behaviours' aimed for in interaction-oriented sustainable design. How to achieve desirable reductions is in practice-oriented design seen as emergent from performances and thus as a question with a multitude of possible answers.

6 Conclusions

This paper set out to highlight a number of limitations of interaction-oriented approaches to sustainable design as existent in design literature and to introduce an interesting alternative view on the role of design in achieving

sustainable levels of consumption. Practice-oriented design is still in its infancy, but its base in a fundamentally different outlook on the role of design in society makes it an interesting area for sustainable design research to explore further.

7 Discussion

Finally, based on the arguments made in this paper, the authors would like to make a few final statements to stimulate debate and reflection in sustainable design. What this paper highlights, in our view, is that it is valuable and arguably essential for design researchers to be aware of the worldview or basic ontology that underlies their work. Such awareness enables a level of reflection and highlights alternatives at a level otherwise not accessible. In agreement with Love (2000), we therefore object to the development of 'wild theory' that does not clearly acknowledge its relations to existing theory. Examples from the area of sustainable design are persuasive technology (Fogg 2002) and nudging (Thaler and Sunstein 2008), which show strong similarities to interaction-oriented approaches like design for sustainable behaviour, but do not acknowledge the extensive field of research in (social-) psychology that they implicitly build on. According to Love (2000), this proliferation of 'theories' leads to unnecessary multiplicity and risks making design theory unhelpfully confused and imprecise. Moreover, awareness of their theoretical standpoint is important for design researchers to stimulate and enable critical reflection, to reveal new avenues, to better understand the role of designers and design research in society, to reveal implicit assumptions and to criticize and question them at different levels.

What we are also concerned about, again like Love (2000) is the unjustified conflation of concepts from different theoretical strands. As our title indicates, we agree with Shove that '[o]n all the counts that matter, social theories of practice on the one hand, and of behaviour on the other, are like chalk and cheese' (Shove 2009: 1279), and object to the mix and match of both theories adopted in some of the papers we analysed. To substantiate this point we would like to offer the metaphor of building a house on two types of fundament at the same time, one on land and one floating on water. Clearly, such a house is bound to break apart eventually. Using the same metaphor, we also want to emphasize that sometimes a house built on land is more appropriate while in other situations a floating fundament might be better. In other words, both interaction-oriented and practice-oriented approaches have their strong and weak points and it is dependent on the particular issue at hand which is most appropriate to use.

Finally, we acknowledge that this position reflects a major challenge. As indicated in Section 4, the behaviour change paradigm is dominant not only is sustainable design, but in a much wider range of related (research) practices. Since we argue that a practice-orientation is not compatible with mainstream design practice, a shift towards it requires a fundamental change in the practices of design. Further study is required to explore what such a shift might entail and how it could be facilitated. This will bring up questions like when does 'broadening of the problem framing' (Brynjársdottir et al. 2012) make design projects too complex, or when does continuous questioning of assumptions paralyze designers?

Acknowledgements

We would like to thank Daan van Eijk and Annelise de Jong for supervising the thesis work titled Implications of Social Practice Theory for Sustainable Design underlying this paper and Ramia Mazé and Elizabeth Shove for their comments on earlier versions.

Funding

This work was supported by the EU Seventh Framework program under Grant number 212498

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.

Akrich, M. (1992). The De-Scription of Technical Objects. In W. Bijker & J. Law (Eds.), *Shaping Technology/Building Society: Studies in Sociotechnical Change* (pp. 205-224). Cambridge, MA: MIT Press.

Bhamra, T., Lilley, D., & Tang, T. (2011). Design for sustainable behaviour: using products to change consumer behaviour. *The Design Journal, 14*(4), 427-445.

Blevis, E. (2007). *Sustainable interaction design: invention & disposal, renewal & reuse.* Paper presented at the Proceedings of the SIGCHI conference on Human factors in computing systems.

Brynjarsdottir, H., Hakansson, M., Pierce, J., Baumer, E., DiSalvo, C., & Sengers, P. (2012). *Sustainably unpersuaded: how persuasion narrows our vision of sustainability.* Paper presented at the Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, Austin, Texas, USA.

Christakis, D. A. (2009). The effects of infant media usage: what do we know and what should we learn? *Acta Paediatrica, 98*(1), 8-16.

Darnton, A. (2004). Driving Public Behaviours for Sustainable Lifestyles Report 2 of Desk Research commissioned by COI on behalf of DEFRA. *Sustainable Development Unit of the Department for Environmental Food and Rural Affairs. The Government of United Kingdom.*

DEFRA, Department for Environment, Food and Rural Affairs. (2005) Changing Behaviour Through Policy Making. The Stationery Office, London

De Jong, A., & Mazé, R. (2010). Cultures of sustainability:'Ways of doing'cooking. In *ERSCP-EMSU Knowledge collaboration & learning for sustainable innovation*, edited by J. Quist R. Wever, A. Tukker, J. Woudstra, F. Boons, N. Beute. Delft, The Netherlands: Faculty of Industrial Design Engineering.

Dourish, P. (2010). *HCI and Environmental Sustainability: The Politics of Design and the Design of Politics.* Paper presented at the DIS 2010, Aarhus Denmark.

Doyle, R., & Davies, A. R. (2012). Towards sustainable household consumption: exploring a practice oriented, participatory backcasting approach for sustainable home heating practices in Ireland. *Journal of Cleaner Production*.

EEA. (2005). *Household Consumption and the Environment.* Copenhagen: European Environment Agency Retrieved from http://www.eea.europa.eu/publications/eea_report_2005_11.

Elias, E., Dekoninck, E., & Culley, S. (2009). Designing for 'use phase'energy losses of domestic products. *Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 223*(1), 115-120.

Elias, E. W. A., Dekoninck, E. A., & Culley, S. J. (2007). *The potential for domestic energy savings through assessing user behaviour and changes in design.* Paper presented at the EcoDesign, Tokyo.

EST, E. S. T. (2006). The rise of the machines: A review of energy using products in the home from the 1970s to today. *Energy Saving Trust, London.*

Foekema, H., & Thiel, L. v. (2011). Watergebruik thuis 2010. Amsterdam: TNS NIPO, in opdracht van VEWIN.

Fogg, B. J. (2002). Persuasive technology: using computers to change what we think and do. *Ubiquity, 2002*(December), 5.

Gram-Hanssen, K. (2011). Understanding change and continuity in residential energy consumption. *Journal of Consumer Culture, Special Issue: Applying Practice Theory to the Study of Consumption, Edited by: Bente Halkier, Tally Katz-Gerro and Lydia Martens, 11*(1), 61-78.

Hargreaves, T. (2011). Practice-ing behaviour change: Applying social practice theory to pro-environmental behaviour change. *Journal of Consumer Culture, 11*(1), 79-99.

Hielscher, S., Fischer, T., & Cooper, T. (2008). *The Return of the Beehives, Brylcreem and Botanical! An Historical Review of Hair Care Practices with a view to Opportunities for Sustainable Design.* Paper presented at the Undisciplined! Design Research Society Conference 2008, Sheffield Hallam University, Sheffield, UK. http://shura.shu.ac.uk/549/

Jackson, T. (2005). Motivating sustainable consumption. *A review of evidence on consumer behaviour and behavioural change. A report to the Sustainable Development Research Network, Surrey: Centre for Environmental Strategies.*

Julier, G. (2007). Design Practice within a Theory of Practice. *Design Principles & Practices: An International Journal, 1*(2).
Kappel, K., & Grechenig, T. (2009). *"show-me": water consumption at a glance to promote water conservation in the shower*. Paper presented at the Proceedings of the 4th International Conference on Persuasive Technology, Claremont, California.
Klöckner, C. A., & Blöbaum, A. (2010). A comprehensive action determination model: Toward a broader understanding of ecological behaviour using the example of travel mode choice. *Journal of Environmental Psychology, 30*(4), 574-586.
Kuijer, L., & Jong, A. d. (2012). Identifying Design Opportunities for Reduced Household Resource Consumption: Exploring Practices of Thermal Comfort. *Journal of Design Research, 10*(1/2), 67-85.
Kuijer, L., Jong, A. d., & Eijk, D. v. (2013). Practices as a Unit of Design: An Exploration of Theoretical Guidelines in a Study on Bathing. *Transactions on Computer-Human Interaction, 20*(4), 22.
Laschke, M., Hassenzahl, M., Diefenbach, S., & Tippkamper, M. (2011). *With a little help from a friend: a shower calendar to save water*. Paper presented at the CHI '11 Extended Abstracts on Human Factors in Computing Systems, Vancouver, BC, Canada.
Latour, B. (1992). Where are the missing masses? The sociology of a few mundane artifacts. In W. E. Bijker & J. Law (Eds.), *Shaping Technology/Building Society: Studies in Sociotechnical Change* (pp. 225-258). Cambridge: The MIT Press.
Lilley, D. (2009). Design for sustainable behaviour: strategies and perceptions. *Design Studies, 30*(6), 704-720.
Lockton, D., Harrison, D., & Stanton, N. (2008). Making the user more efficient: design for sustainable behavior. *International Journal of Sustainable Engineering, 1*(1), 3-8.
Love, T. (2000). Philosophy of design: a meta-theoretical structure for design theory. *Design Studies, 21*(3), 293-313.
Manzini, E. (2009). New design knowledge. *Design Studies, 30*(1), 4-12.
MilieuCentraal. (2010). Alles over energy en milieu in het dagelijks leven. Retrieved 30-01, 2010, from http://www.milieucentraal.nl/pagina.aspx?onderwerp=Energie%20en%20energie%20besparen
Munnecke, M. (2007). *Future Practices: Coshaping Everyday Life*. Paper presented at the Icsid & IDSA CONNECTING '07 World Design Congress.
Norman, D. A. (1986). Cognitive engineering. *User centered system design*, 31-61.
Oudshoorn, N., & Pinch, T. (2007). 22 User-Technology Relationships: Some Recent Developments. *The handbook of science and technology studies*, 541.
Owen, P. (2012). Powering the nation-Household electricity-using habits revealed. *Energy Saving Trust/DECC/DEFRA, London*.
Pettersen, I. N. (2009). *Framing the role of technology in transformation of consumption practices: beyond user-product interaction*. Paper presented at the Joint actions on climate change conference, Aalborg, Denmark.
Pierce, J., Fan, C., Lomas, D., Marcu, G., & Paulos, E. (2010). *Some consideration on the (in) effectiveness of residential energy feedback systems.* Paper presented at the Proceedings of the 8th ACM Conference on Designing Interactive Systems.
Rachlin, H. (2009). *The science of self-control*: Harvard University Press.
Ravandi, M., Mok, J., & Chignell, M. (2009). *Development of an Emotional Interface for Sustainable Water Consumption in the Home*. Paper presented at the Proceedings of the 13th International Conference on Human-Computer Interaction. Part III: Ubiquitous and Intelligent Interaction, San Diego, CA.
Reckwitz, A. (2002). Toward a theory of social practices: a development in culturalist theorizing. *European journal of social theory, 5*(2), 243-263.
Redstrom, J. (2006). Towards user design? On the shift from onject to user as the subject of design. *Design Studies, 27*, 123-139.
Remmen, A. (2003). *An introduction to Life-cycle Thinking and Management*: The Danish Ministry of the Environment.
Røpke, I. (2009). Theories of practice - New inspiration for ecological economic studies on consumption. *Ecological Economics, 68*, 2490-2497.
Schatzki, T. R., Cetina, C. K., & Savigny, E. v. (Eds.). (2001). *The Practice Turn in Contemporary Theory*. London and New York: Routledge.
Scott, K., Bakker, C., & Quist, J. (2011). Designing Change by Living Change. *Design Studies, 33*(3), 279-297.
Scott, K., Quist, J., & Bakker, C. (2009). *Co-design, social practices and sustainable innovation: involving users in a living lab exploratory study on bathing*. Paper presented at the Joint actions on climate change conference, Aalborg, Denmark.
Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. *Environment and planning. A, 42*(6), 1273.
Shove, E., & Southerton, D. (2000). Defrosting the Freezer: From Novelty to Convenience: A Narrative of Normalization. *Journal of Material Culture, 5*(3), 301-319. doi: 10.1177/135918350000500303
Shove, E., Watson, M., Hand, M., & Ingram, J. (2007). *The Design of Everyday Life*: Berg.
Spaargaren, G. (2011). Theories of practices: Agency, technology, and culture: Exploring the relevance of practice theories for the governance of sustainable consumption practices in the new world-order. *Global Environmental Change, 21*(3), 813-822.
Stern, P. C. (2000). New environmental theories: toward a coherent theory of environmentally significant behavior. *Journal of social issues, 56*(3), 407-424.
Strengers, Y. A. A. (2011). *Designing eco-feedback systems for everyday life*. Paper presented at the Proceedings of the 2011 annual conference on Human factors in computing systems, Vancouver, BC, Canada.
Tang, T., & Bhamra, T. (2012). Putting consumers first in design for sustainable behaviour: a case study of reducing environmental impacts of cold appliance use. *International Journal of Sustainable Engineering, 5*(4), 288-303.

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*: Yale University Press.
Triandis, H. C. (1989). The self and social behavior in differing cultural contexts. *Psychological review, 96*(3), 506.
Verbeek, P.-P., & Slob, A. (2006). *User Behavior and Technology Development; Shaping Sustainable Relations Between Consumers and Technologies* Springer.
Vergeer, M., Coenders, M., & Scheepers, P. (2008). Tijdsbesteding aan televisie in Europese landen: crossnationale vergelijkingen en verklaringen. *Tijdschrift voor Communicatiewetenschap, 36*(1), 15-34.
Verplanken, B., & Wood, W. (2006). Interventions to break and create consumer habits. *Journal of Public Policy & Marketing*, 90-103.
Warde, A. (2005). Consumption and Theories of Practice. *Journal of Consumer Culture, 5*(2), 131-153.
Wever, R., van Kuijk, J., & Boks, C. (2008). User-centered design for sustainable behaviour. *International Journal of Sustainable Engineering, 1*(1), 9-20.
Zachrisson, J., & Boks, C. (2012). Exploring behavioural psychology to support design for sustainable behaviour research. *Journal of Design Research, 10*(1), 50-66.