Implications of
Social Practice Theory
for Sustainable Design

PhD thesis
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Implications of Social Practice Theory for Sustainable Design

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1 Introduction

This thesis is positioned within the discipline of design research. According to Nigel Cross, one of its pioneers, design research 'includes the study of how designers work and think, the establishment of appropriate structures for the design process, the development and application of new design methods, techniques and procedures, and reflection on the nature and extent of design knowledge and its application to design problems' (Cross 1984). Starting point of the research presented in this thesis is the observation that design theory has been developed and implemented to address the problem of unsustainable levels of consumption, but that so far efforts have not been sufficiently effective. In spite of over 20 years of 'sustainable design', new product development is still contributing to increasing rather than decreasing levels of resource consumption.

According to the World Wildlife Fund Living Planet Report (Polland 2010), human demand on the biosphere has more than doubled between 1961 and 2007. In the late 1970's, the world's ecological footprint has surpassed the earth's bio capacity, and today, humanity uses the equivalent of 1,5 planets to provide the total of resources used and absorb the waste generated (Global Footprint Network 2010). Even moderate United Nations reports predict this excess to have increased to two planets by 2030. The European Union (EU) is already at this 2-planet level today (EEA 2012). In other words, to reach a more sustainable balance between consumption and the planet's capacity, average resource consumption levels of European countries should be decreased by at least 50% compared to 2010 levels. Because there is a close relationship between product design and change in society, as will be argued below, efforts in the design discipline are already showing motivation to address unsustainable consumption levels. This has led to a demand for, and emergence of a realm of design research that is in this thesis grouped under the term 'sustainable design'.

1.1   Sustainable design

Because of its wide variety in interpretations, the term sustainability is avoided as much as possible in this thesis. Rather, focus is on the specific concern of resource depletion and the observation that Western societies are using more resources than the planet can sustainably provide. If society continues at this rate of resource consumption, following generations will face serious problems for their survival and already now, societies in other parts of the world are noticing the effects of resources depletion on their endurance (Flora 2010). In this thesis, sustainability is narrowed down to a situation in society in which resource consumption is in balance with the ecosystems' capacities. This balance cannot be clearly defined, but what is certain is that current levels of resource consumption of the EU are well above those required for such a balance.

Focusing yet more, central to the thesis is direct resource consumption in households. This focus stems from the 7th Framework Living Lab project (Bakker et al. 2010) that this research was part of. Direct resource consumption involves the resources delivered to households directly through infrastructures, being gas, electricity and water. Direct is here contrasted with indirect resource consumption that takes place elsewhere for the production of products consumed by the household. In Europe, households account for approximately 25% of society's direct resource consumption, in which other sectors are industry, transport and services (EEA 2013). In the thesis, Europe is used as the target area, but most of the time The Netherlands is used as an example of a European country. The Netherlands has an ecological footprint that is even higher than the European average, requiring 3,5 times its fair share of bio capacity (Global Footprint Network 2010). This means that for a balance, reductions are required in at the order of over 70%.

Like sustainability, design too is a fluid term with myriads of interpretations. Economist Herbert Simon, now seen as one of the founders of the design research community (Cross 2006), has described design in very general terms as 'devising courses of action aimed at changing existing situations to preferred ones' (Simon 1996: 111). When talking about sustainability, these ideas of change and a difference between existing and preferred situations are central. Situated in an Industrial Design Engineering department, the focus of this research is on the relation between industrial product design and household resource consumption. Industrial product designers are trained to develop consumer products (products, systems, services) for mass production (Boeijen and Daalhuizen 2010). In the direct resource consumption of households, these artefacts (be it thermostats, taps or dishwashers) play a crucial role, for it is through them that people consume direct resources like energy and water.

When aiming to reduce household resource consumption, industrial product designers (from now on referred to as 'designers') have been identified as possible initiators of desirable change. One, because mass consumer products and new product development are implicated in (growing) resource consumption of households (Papanek, 1971; Thackara 2005); in other words, design receives part of the blame for the problematic situation society is in. And two, because product design is viewed as a motor of change in society and therefore considered a means to facilitate the change that is needed to reduce consumption levels (Thackara 2005; Manzini 2006; Ehrenfeld 2008; Fry 2009).

1.2   Social practice theory

Previous experiences have shown, however that the relation between design and changes in household resource consumption is not straightforward. Reduction targets are not always achieved and efforts can even be counterproductive. For example, washing machines have become more water and energy efficient, but in parallel, washing frequencies increased by 20 to 25% (Verbeek and Slob 2006). The same counts for light bulbs, where a 50% increase in energy efficiency was countered by a fourfold increase in consumption of light (Herring and Roy 2007). Moreover, effects of (new) products, and by implication decisions made in the design process, can extend far beyond the immediate product use. For example, the dishwasher, while possibly more energy efficient than hand washing per dish, has contributed to more dishes being washed more often, which also requires households to have a larger stock of cups, plates and cutlery. Taken even further, while doing the dishes before, people may now devote time to, for example, watching television. This requires electricity, plus it is a passive activity, requiring a higher indoor temperature for thermal comfort. The notion of extended effects of product design on daily life offers challenges, but also opportunities. The area of sustainable design is still young and neither these challenges nor opportunities have been explored to their potential. Aiming to address these, this PhD research has drawn on a particular group of theories from sociology to further explore the relation between design and changes in household resource consumption.

Sociology is a discipline that has long pondered questions regarding issues of a societal scale. Recently, a particular form of social theory grouped as theories of practice or social practice theory is (re)gaining popularity. Practice theory – as developed by amongst others Anthony Giddens, Theodore Schatzki, Andreas Reckwitz and Pierre Bourdieu – is promising to inform sustainable design for several reasons. One, because it is already used to understand and explain issues with regard to unsustainable consumption levels (e.g. Shove 2003, Spaargaren 2003, Seyfang 2006, Randles and Warde 2006, Gram-Hanssen et al. 2008, Wilhite 2008, Røpke 2009). And two, because materiality plays a central role in certain strands of the theory it speaks directly to designers. In fact, scholars in the field have already reached out to design research through several publications. In the words of Ingram, Shove and Watson (2007), practice theory is useful to gain a better understanding of how 'designed artefacts shape and are shaped by the contexts in which they are used'.

1.3   Research questions and research approach

These outreaches have not remained unnoticed in the design community and several researchers in (sustainable) design have picked up on what has been – in a very brief introduction by Shove et al. (2007:134-135) – coined 'practice-oriented design'. From earlier work in design research on this topic, it becomes clear that practice theory is not directly applicable in product design projects. It forms a theoretical stance used to understand and explain social activity and order as they are, not a method or approach to inform or inspire decisions about what could or should be in the future. More fundamentally, ideas about design and a practice theoretic outlook on change exist

quite uncomfortably next to each other. The kind of agency assumed in the idea of 'devising courses of action to change existing situations into preferred ones', and the type of closure it implies are both rejected in practice theory. On the bright side however, theories of practice do acknowledge that to some level, artefacts shape the contexts in which they are used (Ingram et al. 2007) and that things are 'irreplaceable, constitutive elements of practice' that 'enable and constrain the specificity of a practice' (Reckwitz 2002b). Although designers are ascribed a modest role in practice-oriented design, this thesis takes the position that there is certainly a role for those who give shape to mass produced consumer goods in the ways in which practices develop, be it in more or less desirable directions. Therefore the main research question is:

> Can drawing on social practice theory lead to design approaches that are more effective in addressing the issue of high and rising levels of household resource consumption than existing approaches?

For initial exploration, this question is divided into three sub questions, which are addressed in Part I of this thesis:

- What are limitations of current approaches in sustainable design? (Chapter 2)
- What is social practice theory from a design perspective? (Chapter 3)
- What are strengths and limitations of earlier integrations of practice theory into design approaches? (Chapter 4)

These questions are used to formulate an additional set of questions that will address the main question. Running ahead on the conclusions of Part I, they are:

- What does it mean to take practices, instead of interactions as a unit of *analysis* for approaches to sustainable design? (Chapter 5)
- What does it mean to take practices, instead of interactions as a unit of *design* for approaches to sustainable design? (Chapter 6)

Because these questions are cross disciplinary, deal with preferred states, are future oriented, revolve around a complex issue and aim to develop theory for design, they pre-eminently lend themselves for a research through design approach (Zimmerman et al. 2010). Such an approach leads to empirical design outcomes and at the same time to ideas and knowledge about how to design, or what is called prescriptive design knowledge. Research through design is a form of applied research in which design projects are used as an integral part of the research process. The goal of the research is to extend disciplinary understanding of the practices of design and to enhance the knowledge designers draw on by generating contextualised knowledge in a number of empirical areas (Stappers 2007). In this research, these areas are the resource intensive, but otherwise strongly different household practices of bathing and thermal comfort.

1.4. Thesis outline

Between the introduction and conclusions, the thesis contains three main parts:
(I) theoretical foundations, (II) proposed approach and (III) empirical projects Figure 1-1
graphically depicts the outline of this thesis.

Part I Theoretic foundations

2. Sustainable design
3. Practice theory
4. Practice-oriented design

Part II Proposed approach

5. Practices as a unit of analysis
6. Practices as a unit of design

Part III Empirical projects

7. Bathing
8. Staying warm at home

1. Introduction

9. Conclusions
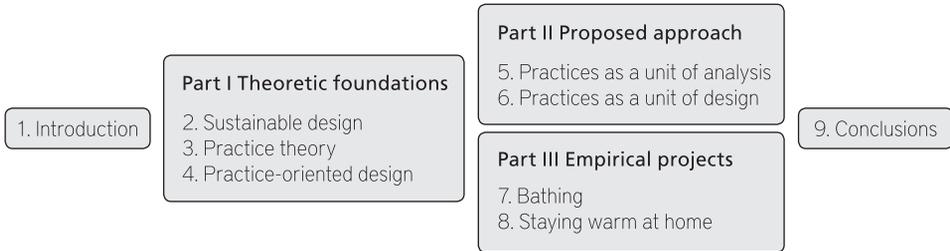
Figure 1-1 Thesis outline.

Part I, comprising Chapters 2, 3, and 4 addresses the three initial questions posed
above, with the aim to explore and specify the main research question. Chapter 2
analyses sustainable design literature with the aim to identify possible reasons for the
insufficient effects on levels of household resource consumption so far. Chapter 3
draws on literature on social practice theory to compose an interpretation of theories
of practice specifically tailored for integration into design approaches. Chapter 4,
eventually, analyses a range of publications in design research that have worked with
theories of practice before, in order to get an overview of the current state of affairs in
this area of research and in particular strengths and limitations of earlier attempts to
develop practice-oriented design approaches.

Part II, consisting of the Chapters 5 and 6, presents the main results of the research
and consists of an explanation of the proposed practice-oriented design approach. The
approach is divided into a model for taking practices as a unit of analysis (Chapter 5)
and a model for taking practices as a unit of design (Chapter 6). Methods for analysis
aim to gain understanding of existing practices in order to inform and inspire design
and find opportunities for change. Methods for design aim to generate possible less
resource intensive reconfigurations of practices. It is important to explain that the order
of presenting the proposed approach before the empirical projects is not chronological.
Rather, the recommended approach and models were developed through and emerged
from reflection on the empirical projects underlying Part III.

Part III includes Chapters 7 and 8. Chapter 7 provides an overview of the projects
on bathing and Chapter 8 of those on staying warm at home. For the sake of clearly
illustrating the approach proposed in Part II, the empirical projects are presented in
the format of the approach. However, they were in fact much messier and haphazard
than their description suggests. Appendix A contains a graphic presenting the actual
chronology of the bathing projects to illustrate this difference.

The thesis closes with a conclusion chapter, in which the main research question is
answered and results are discussed in the light of the research approach taken. Based on
these reflections, the chapter concludes with an overview of avenues of further research.

Implications of Social practice Theory for Sustainable Design

Part I
Theoretical foundations

This part, comprising Chapters 2, 3, and 4, forms the theoretical foundation of the thesis. The chapters each address one of the initial questions posed in the introduction, in order to explore and specify the main research question. Chapter 2 analyses sustainable design literature to identify possible limitations of existing approaches. Chapter 3 draws on social practice theory literature to compose an interpretation of theories of practice specifically tailored for design research. Chapter 4, eventually, analyses a range of publications in design research that have worked with theories of practice before. It works towards an overview of the current state of affairs in this area of research and in particular strengths and limitations of earlier attempts to develop practice-oriented design approaches. The section closes with a specification of the research question.

2 Sustainable design

2.1 Introduction

As explained in Chapter 1, this thesis aims to contribute to the knowledge base in sustainable design. It does so by proposing an approach that is argued to highlight new avenues for reaching the challenging targets facing the discipline. To make such an argument, this chapter offers a detailed account of existing approaches, their strengths and limitations.

Section 2.2 starts with a short overview of the history of sustainable design as a specific area of design research. The aim is to explain where in sustainable design attention to the role of products in direct household resource consumption – the focus of this thesis – originated. Within this focal area, two main approaches can be distinguished: one with a technology focus and one with an interaction focus. Both are briefly explained in section 2.3. Because the interaction focus can be viewed as an approach encompassing the technology focus – since it deals with user-technology interactions – it will be taken as the basis for elaborating on the limitations of sustainable design approaches. In Section 2.3, four interaction focused illustrative examples are offered, which are in Section 2.4 used to illustrate the points of concern raised by different authors critiquing interaction-oriented approaches.

2.2   A short history of sustainable design

Although industrial design has traditionally been tied to industry and commercial product development, connections with non-commercial objectives have been made from the start of defining the design (research) discipline. Archer characterizes design as an important cog in the wheel of addressing 'the problems modern society is faced with such as the ecological problem, the environmental problem, the quality-of-urban-life problem and so on' (Archer 1979: 18).

Moreover, concerns with issues of sustainability in a broader sense have existed as long as the design disciplines (notably William Morris and his battle against mass production in the 19th century). Working towards a more coherent area of research, some important publications were made in the 1970s in response to the emergence of environmental concerns with books like 'Silent Spring' (Carson 1962) and the Club of Rome's 'Limits to Growth' (Meadows et al. 1972). Examples in the design arena are 'Operating Manual for Spaceship Earth' (Buckminster Fuller 1969) and 'Design for the Real World' (Papanek 1971). However, Thorpe (2010) locates the emergence of sustainable design as a recognizable field of research in the 1990s. Preceded by a focus on material recycling, i.e., re-using discarded products in the early 1990s, the first manifestation of a more formal design approach in sustainable design was 'eco-design', which emerged in the late nineties.

Initially, research efforts into eco-design focused on analysing developments in industry (e.g. Potter and Dewberry 1993, Roy 1994). There, a shift was identified from 'end-of-pipe' approaches, to taking into account the entire product lifecycle. Such 'systematic' eco-design attempted to 'take into account all environmental impacts throughout the product life cycle from initial manufacture to final disposal' (Roy 1994: 364). Later, publications become more prescriptive, such as the Ecodesign Checklist by Brezet and Van Hemel (1997), which is described in an UNEP press release as 'the first manual to provide companies with a step-by-step approach to ecodesign' (UNEP 1997).

In eco-design, the life-cycle of a product involves the phases of extraction of raw materials, manufacturing, transport, use, re-use, maintenance, recycling and final disposal (Azapagic 1999). Especially in the case of appliances that consume energy and materials during use, the life-cycle focus highlighted the use phase as accounting for a major share of their environmental impact. For example,Life Cycle Assessment (LCA) studies showed that 90% of the total environmental impact of fridges and washing machines is generated during its use phase (Simon et al. 2001, Rüdenauer et al. 2005). While ecodesign and the related field of LCA is still very much alive (e.g. European Commission Ecodesign directive 2009/125/EC, International Journal of Life cycle Assessment), this realisation led to the development of a new branch of sustainable design approaches that specifically focuses on reducing the resource consumption of products during their use in households.

2.3   Reducing resource consumption during use

The issue of high levels of resource consumption in households lies at the core of this thesis, so approaches targeting this specific area of the product life-cycle will be explained in more detail. They can roughly be divided into two waves: a focus on resource efficient products and a focus on resource efficient product-user interactions.

2.3.1   Resource efficient products

The idea behind the focus on resource efficient products is that through technical optimisation, appliances can be redesigned in a way that their functions, which are in these approaches taken for granted, are fulfilled using minimum amounts of resources (Elias 2007). For example, studies on the performance of refrigerators showed that up to 80% of their energy consumption could be reduced by improving the insulation qualities of the walls and door (Rüdenauer et al. 2005). Another often used example of energy efficient technology is the compact fluerescent lamp, which uses up to one eigth of the energy of incandescent light bulbs, with the same light performance. Through changes in technical features, the energy efficiency of appliances has indeed improved over the past decades. According to the European Environment Agency, the average energy consumption per unit for large appliances such as washing machines, dishwashers and cold appliances like refrigerators and freezers fell by 21% between 1990 and 2002 (EEA 2005). Making appliances more energy efficient still recevies attention in companies due to regulations (Council Directive 1992, now replaced by Directive 2010/30/EU), and energy labels have become a common sight in electronic appliance stores. However, when energy efficient technology turned out not to render the energy savings it promised, limitations of the approach started to become clear.

   One of the most discussed limitations of the resource efficiency approach is the so-called rebound effect, where the introduction of resource efficient appliances goes hand in hand with increases in consumption, which reduce, nullify or even counteract expected savings. In case of the light bulbs example in Chapter 1, lower energy consumption per light bulb has gone hand in hand with an increased consumption of light (Herring and Roy 2007). According to Verbeek and Slob, people replaced their incandescent bulbs with more energy efficient ones, but also used them 'to illuminate places where there was no light before, such as the garden or the garage.' (2006: 3). Another example offered by these authors is that of the washing machine, where potential savings of water and electricity consumption of 20%, due to efficiency improvements made between 1980 and 1990, were reduced by 10% due to increases in washing frequencies over the same period (Verbeek and Slob 2006: 7). In conclusion, Verbeek and Slob argue that approaches focusing on the energy efficiency of devices alone is not sufficient, instead, an 'integrated approach to technology and behaviour' is required.

   Other authors have come to the same conclusion, but from a slightly different perspective. They argue that by focusing on the resource efficiency of products alone, opportunities for reductions in consumption are missed. The way a product is used, they argue, accounts for an important part of the energy consumption of the product. Some

authors have even quantified this share, stating that '26-36% of in-home energy use is due to resident's behaviour' (Wood and Newborough 2003). These observations gave rise to an area of research generally referred to as 'Design for Sustainable Behaviour'.

2.3.2 Resource efficient interactions

The basic idea behind Design for Sustainable Behaviour approaches is that even if an appliance is fulfilling its functions in a resource efficient way, the way the appliance is used might make its level of resource consumption 'sub-optimal'. Therefore, these approaches aim to influence users to 'operate the appliance in a more efficient way' (Lockton et al. 2008). A related group of approaches is called persuasive technology design (Fogg 1999). Because behaviour in these approaches always refers to the way in which a product is used, they encompass the technology focus. In this light, it is therefore more appropriate to ascribe them an interaction, rather than a behaviour orientation. From this point onwards they will be grouped under the term interaction-oriented approaches to sustainable design.

Efforts in this area have focused on identifying, developing and ordering design strategies and applying these strategies in, mostly fictive, design cases. 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 scales on which these design strategies are presented range from less to more forceful ways of stimulating or steering users of the selected products towards particular desired behaviours. 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.

Three types of users
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 such 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.' (Bhamra et al. 2011: 431). Persuasive technologies focus on this type of users. The strategies described by Fogg were developed in the specific area of digital, computing devices and the cases he uses include but go beyond environmental sustainability (Fogg 2002).

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 of turning off the device after use is then delegated (using the term of Latour (1992)) to the technology.

Good and bad behaviour

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 control' 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 design strategies. Design is thus viewed as a means to 'solve environmental problems of use behaviour' (Bhamra et al. 2011) and (persuasive) technologies as having potential 'to be incredibly effective, offering a more reliable and replicable method for ensuring more sustainable behaviour' (Lilley 2009). Elias adds that once the optimal use of a product has been determined 'engineers and designers can work in confidence to reduce user-related energy losses by locking in good energy efficient user behaviour at the design stage' (Elias 2009). Relatively little attention is paid to defining these good or sustainable behaviours, 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)

With such a clear idea of what sustainable and unsustainable behaviours are, the question central to this literature becomes 'how products can be designed to achieve sustainable behaviour' (Zachrisson and Boks 2012). Based on the 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), researchers draw on theory from psychology and social psychology to identify factors that affect behaviour. Models like the 'comprehensive action determination model' (Klöckner and Blöbaum 2010), the 'theory of planned behaviour' (Ajzen 1991), Triandis (1984) Theory of Interpersonal Behaviour, or Stern's (2000) attitude-behaviour-context theory (ABC theory) aim to explain behaviour using a varying number of factors like attitudes and norms. These causal models of behaviour represent rational choice or decision processes, but also acknowledge that sometimes these processes are avoided when behaviour is habitual (which according to Verplanken and Wood (2008) comprises about 45% of human action). Habits are defined as learned, automatic scripts that are performed in response to fixed contextual triggers. In interaction-oriented approaches in sustainable design, these models are used to formulate design guidelines for 'designing sustainable behaviour' (Zachrisson and Boks 2012). Fogg[1], for example poses

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[1] Notably, Fogg does not acknowledge the relation of his ideas to existing theory and models in (social-)psychology.

that behaviour is a product of three factors, being motivation, ability and triggers. For a person to perform a certain target behaviour, they must be sufficiently motivated, have the ability to perform it and be triggered to perform it. This model provides designers with a systematic way to think about behaviour change when designing interactive technologies (Fogg 2009a). Importantly, some factors are considered unchangeable, such as 'personal norms' (Zachrisson and Boks 2012).

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 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. The refrigerator example is somewhat more elaborate than the rest because it explains in detail how this quantification was made.

2.3.3 Four illustrative examples of interaction-oriented design projects

The *refrigerator* is used as an example in Bhamra et al. (2011) and in Elias (2009). 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 a product that is on 24/7. Both Bhamra and Elias select the time the fridge door is opened as the focal 'behavioural problem' 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. To calculate potential savings through changing user behaviour, Elias 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 studies of actual fridge use, he 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 to do so 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', or a system to see what is in the fridge without opening the door, e.g. a glass door or digital 'food-shopping record' (Bhamra et al 2011).

The *electric kettle* is referred to by Lockton (2008) and Elias (2009). The 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[2].

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 can either 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 these 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 meganism. For Laschke this is a shower calendar with dots that shrink in response to water use 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 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 simulation in which savings add up to as little as 0,08 litres per person per day, as compared to an implicit benchmark.

From these examples it becomes clear that the approaches are relatively straight-forward to implement; for all products some form of redesign 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), reductions can be achieved with minor effort. However, not disregarding these strong points, a variety of concerns relating to interaction- oriented approaches have been raised as well.

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[2] www.ecokettle.com

2.4 Limitations of interaction-oriented approaches

Potential limitations of interaction-oriented approaches have been raised from different angles. Here they are summarized into four related points of concern that are explained using the examples introduced in the previous section.

2.4.1 Potential savings disappear in other changes

Interaction-oriented approaches, Scott et al. (2011) argue, are limited because they focus on specific products, user types and moments in time. Similarly, Brynjarsdóttir et al. (2012) find that framing sustainability as the optimization of simple, measurable metrics does not do justice to the complexity of sustainability issues. As will be illustrated using the examples introduced above, this strategy of simplification to reductions of single metrics of specific interactions runs the risk of disappearing in on-going changes that are part of daily life. Even if the re-design results in the intended behaviour change (e.g. reduced fridge opening times, shorter showers), the energy savings obtained with this change are easily lost in 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 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 (MTP 2008).

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% 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 (2011) finds a relatively constant shower duration of around 8 minutes, but increasing showering frequencies and an increasing popularity of so called comfort showers that release 14,4 litres per minute instead of the regular 7,7 litres. 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 increasing number of appliances overall (EEA 2005). 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.

2.4.2   Intended behaviour change may not be achieved

Because interaction-oriented approaches tend to assume rather specific use scenarios that are optimized 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, Brynjarsdóttir et al. 2012). In other situations, specific use scenarios may 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 the opposite effect. Moreover, an 'optimal arrangement' of the fridge contents or 'locking the location of food 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 Maze 2010).

In case of the *electric kettle*, Elias himself expresses concern about this type of rebound 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 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 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 affects opposite of those aimed for. Moreover, as the next section will argue, there is another concern related to these specific use scenarios, which lies in the rhetoric that accompanies it.

2.4.3 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). Brynjarsdóttir et al. (2012) find that this simplification of 'good' versus 'bad' behaviours places technologies as 'seemingly objective arbiters over complex issues of sustainability'. What is 'good' or 'bad' behaviour is defined by the designers of the technology, placing them in an unjustified position of authority over other people's lives.

For example, 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), or water that is boiled but not used for tea directly In such a view, a birthday party, or a child helping to fetch the milk may easily constitute 'bad behaviour'. The rhetoric of 'unsustainable' behaviours gets quite strong, when habits, such as for example 'long' showers are equated with alcoholism, smoking, drug and gambling addictions (Laschke et al. 2011 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. 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 a rain shower 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. Close 2004, Christakis 2009).

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. For example, is a 36 inch television a waste of energy? Thus, the 'need' for the services these devices offer is taken for granted (Scott et al. 2011). 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, is not or only sideways addressed. As a consequence, 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 such static use scenarios, important opportunities are missed.

2.4.4 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 et al. 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 individual product-user interaction, they tend to be overlooked in existing interaction-oriented approaches. 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. Moreover, the change that is aimed for tends to concern small changes to 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)

Besides critiquing interaction-oriented strategies, these authors propose 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 socially shared practices. Taking practices instead of products or 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 2007), take into account the dynamics at play in everyday consumption (Pettersen 2009), consider energy consumption in the context of broader sociocultural practices (Brynjarsdóttir 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).

2.5   Conclusions

This chapter set out to identify existing approaches in sustainable design that concern themselves with household resource consumption and to give an overview of their strengths and limitations. Two approaches have been highlighted, one focusing on the resource efficiency of technologies and the other expanding this focus to product-user interactions. It was concluded that the interaction-oriented literature offers a relatively coherent and well-developed set of strategies that are relatively easy to implement for industrial designers. This is reflected in the fact that a range of products adhering to the principles promoted in this body of literature is available in the market. However, some important limitations were found as well.

The limitations of interaction-oriented approaches can be summarized into four main points of concern. The first two, being the risk of targeted reductions disappearing in larger trends and targeted reductions not being achieved or even countered, can largely be attributed to a reliance on specific use scenarios. These scenarios tend not to be representative for the variety of actual situations (re-)designed products end up in, and necessarily overlook the way use situations tend to change over time. Another limitation is then found in the way these scenarios are composed, which tends to be done rather unilaterally by the designer. Moreover, the scenarios contain a strong rhetoric of right and wrong behaviours, neither of which are questioned. Together with a focus on individuals as primarily responsible for changes towards sustainable levels of resource consumption, this unquestioned acceptance of the status quo runs the risk of missing opportunities for the larger scales of change required for achieving a more sustainable balance between consumption levels and the planet's capacities.

Several authors in (sustainable) design have suggested drawing on social practice theory as a potential way to overcome these limitations. This area within design research is referred to as 'practice-oriented design' (Shove et al. 2007). It is a relatively new area of research that emerged in response to a series of workshops and publications emerging from the 'Designing and Consuming: objects, practices and processes' research program (2005-2006)[3]. Before going deeper into practice-oriented design and remaining research challenges in this area, Chapter 3 will first elaborate on practice theory to explore in more detail what this group of theories has to offer design theory.

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[3] www.consume.bbk.ac.uk

Implications of Social practice Theory for Sustainable Design

3 Practice theory

3.1 Introduction

Chapter 2 has provided an overview of approaches in sustainable design and a summary of some of their limitations. As highlighted in the previous chapter, it has been argued by several authors that an approach drawing on practice theory may offer a way to address these limitations. This chapter will go deeper into practice theory. Both practice and theory are familiar terms used in common parlance. But what is practice theory? Starting from its origins in social theory, this chapter offers an overview of concepts that are considered relevant for developing a practice-oriented approach in sustainable design.

    The chapter will first explain the position of practice theory within social theory, then elaborate on two central concepts: one being that practices are comprised of constellations of elements, the second being the importance of distinguishing between practice-as-entity and practice-as-performance. Because this introduction to practice theory is design oriented and positioned in relation to human-product interaction focused approaches in sustainable design, it will subsequently go deeper into the ways in which people and things are conceptualised in practice theory. Finally, zooming out from single practices, the web of interconnected practices will be discussed. The conceptual framework thus laid out forms the basis for the practice-oriented design approach presented in the chapters 5 and 6.

3.2 Practice theory in social theory

When introducing practice theory, it is important to note that the meaning of 'practice' in practice theory is similar to, but basically different from some more general uses of the term. In general speech, it is for example common to speak of 'practice' as opposed to 'theory', in which practice refers to bodily action, while theory merely concerns thinking. In design research in particular, the term 'design practice' generally refers to the realm of professional design in commercial companies as opposed to design performed in universities (e.g. as in Stolterman 2008). More generally, the verb 'to practice' refers to the repeated performance of something with the objective to get better, for example practicing ones drawing skills.

In practice theory however, 'practice' refers to a practice or practices as a noun. There is no case of practice vs. theory, practice vs. research or practicing as a particular type of activity. Instead, any action or behaviour can be viewed as part of a practice, or, as Schatzki poses it, 'people are always carrying out this or that practice' (Schatzki 2001:54). Doing research, practicing design or learning how to draw can all be viewed as practices. To understand practice theory, it is important to realise that it represents a particular way of understanding society: a way 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 system of interpretation, a conceptual framework that comprises a certain way of seeing and analysing social phenomena, which enables certain empirical statements, and excludes others (2002a: 257).

To make this point clear, Reckwitz (2002a) positions practice theory in relation to other forms of social theory. He does so on two levels. First, he positions practice theory as a form of cultural theory. According to Reckwitz, sociological methods of conceptualising human behaviour and the way it is organized take one of three forms, these being: purpose-oriented theories, norm-oriented theories and cultural theories. In purpose-oriented theories, behaviour is explained in terms of individual purposes, intentions and interests. Social organization is then a product of the combination of single interests and the smallest unit of analysis is human action. In sustainable design, such a position tends to place a focus on demonstrating personal gain, such as showing how much money can be saved when turning off lights or turning down the thermostat. In norm-oriented theories, behaviour is explained through collective norms and structures. Social organization is a result of normative consensus and the units of analysis are normative structures, such as values and social rules. In sustainable design, a norm-oriented position could for example lead to a product in which levels of resource consumption of different people in a neighbourhood are compared. Cultural theories reject this dichotomy and place the social in collective symbolic structures of knowledge. Cultural theories have so far not clearly manifested in sustainable design. This thesis investigates what the particular position of locating the social in practices (i.e. a form of cultural theory according to Reckwitz) could mean for sustainable design approaches and outcomes.

Cultural theory is more than practice theory alone. Within cultural theory, Reckwitz (2002a) distinguishes four main tendencies that each locate the social (or collective) differently: in the human mind (mentalism), in discourse (textualism), in communication (intersubjectivism) and in practices (practice theory). Of these four, only practice theory will

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┌─────────────────────────────┐
│   Types of social theory    │
│      [unit of analysis]     │
└─────────────────────────────┘
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| Purpose-oriented theory [single actions] | **Cultural theory** [various, see below] | Norm-oriented theory [normative consensus] |

| Mentalism [human mind] | Textualism [discourse] | Intersubjectivism [communication] | **Practice theory** [practices] |
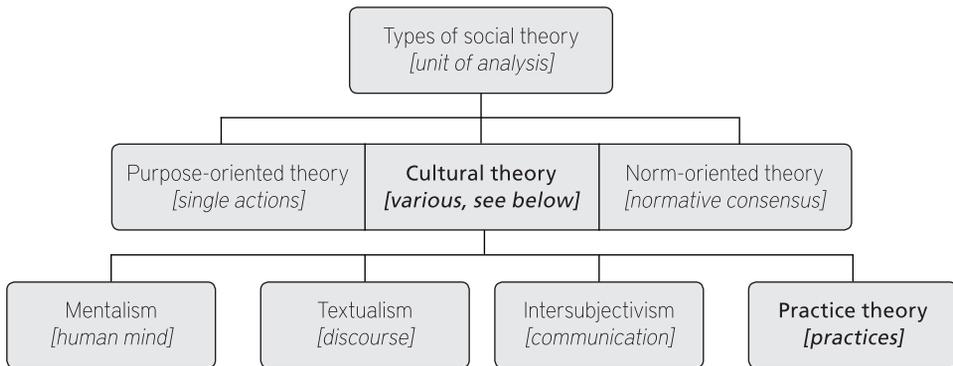
Figure 3-1 The position of practice theory within social theory based on Reckwitz (2002a).

be discussed in detail. In Figure 3-1, the position of practice theory within social theory is depicted graphically.

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 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 nor 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.

So while the positioning of practice theory by Reckwitz seems rather clear, the vocabulary offered by practice theorists does not offer a 'systemized' (Reckwitz 2002a:257) language as prescriptive and encompassing as some of the other social theories. Neither does practice theory offer one coherent account. Practice theorists agree on some points, for example to take practices as a fundamental unit of analysis, but they disagree on many others, for example on the role material objects play in practices. Therefore, the explanation offered in this chapter is an interpretation of practice theory. This is an interpretation that takes from various sources and versions of practice theory those aspects that are, in the opinion and experience of the author, relevant to design and sustainable design in particular.

To return to the issue of what 'practice' means, 'practice-oriented design' in this thesis does not refer to design approaches specifically tailored for professional designers working in commercial companies. Practice-oriented design here groups a set of design approaches, currently mainly existing in the realm of design research, which explicitly take practices as their fundamental unit of analysis, and in fact, as a unit of design, as will be elaborated on later. First, it is time to go deeper into the conceptual framework practice theory offers.

3.3   Elements and their links

A practice, in the widely cited definition of Reckwitz is:

> 'a routinized type of behaviour which consists of several elements, interconnected to one other: forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge.' (Reckwitz 2002a:249)

From this definition, it becomes clear that practices can be viewed as sets of interconnected elements. While their interconnectedness is essential in practice theory, this section first zooms in on the separate elements. Reckwitz provides a rather loose and non-exhaustive list. Other authors have proposed shorter lists of three or four elements (Gram-Hanssen 2011 provides an overview of different groupings). The terminology used in this thesis is stuff, skills and images (Figure 3-2), or alternatively materials, competences and meanings; an interpretation and terminology used by Shove and colleagues (e.g. Shove and Pantzar 2005, Shove et al. 2012), and adopted in several design-oriented papers (Scott et al. 2011, Kuijer and De Jong 2012). Because this interpretation makes explicit mention of material elements, it has clear relevance for design. What follows is an explanation of the concepts these three elements represent in this thesis.
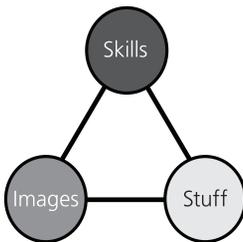
Figure 3-2 Images, skills and stuff model, adapted from Shove and Pantzar (2005)

3.3.1   Stuff (materials)

Stuff refers to the tangible, material elements deployed in the practice. Shove et al. (2012) summarize them as objects, infrastructures, tools, hardware and the body itself. In line with Latour (1993), no clear distinction between humans and things is made; together they can form a hybrid entity. Moreover, the body itself and other things not directly man-made, like air, bacteria etc, are also part of the stuff in practices. Stuff is socially shared because the same or similar things are available (although certainly not equally accessible) to groups of people. This makes a link to design, since mass produced products form part of the material world.

3.3.2   Skills (competences)

Skills are learned bodily and mental routines, including know-how, levels of competence and ways of feeling and doing. The important point here is that in this approach, ways of feeling about and appreciating things and situations is seen as part of the practice, as learned through doing. Again, this model of practice makes no clear distinction between humans and things. Skills are distributed, and can be redistributed between people and products through what Latour (1992) refers to as delegation. Moreover, know-how does not only manifest in knowing how to act appropriately, but also knowing how to talk about, how to recognize and how to prompt and respond to such actions (Schatzki 2001: 54). Skills involve (inherently shared) knowledge about what is good, normal, acceptable and appropriate (and what is not) and learned, bodily/mental competence to reach these standards to more or lesser extents.

3.3.3   Images (meanings)

Images are socially shared ideas or concepts associated with the practice that give meaning to it; reasons to engage in it, reasons what it is for, or as Shove et al. put it, 'the social and symbolic significance of participation at any one moment' (Shove et al. 2012:22). Images bring to the fore concepts of association, relative positioning, norms, values and ideologies (Shove and Pantzar 2005:47). Explicitly treating meaning as an element of practice, and not as something that stands outside of it as a motivating or driving force has far reaching consequences for practice-oriented design, as will become clear later on in this thesis.

It has to be noted that, although seemingly straightforward, the images-skills-stuff framework offers only a loose grouping of elements. The three categories overlap and elements mutually influence and shape each other. Moreover, for understanding practices, the links between the elements are just as important as the elements themselves. To Shove et al. (2012) practices consist of elements that are linked together in and through performance. Moreover, since 'practices emerge, persist and disappear as links between their defining elements are made and broken' (Shove et al. 2012:21), these links are important for understanding change in practices. Helpful to understanding the role of links in practices is the distinction between practice-as-entity and practice-as-performance.

3.4   Practice-as-entity and practice-as-performance

Schatzki distinguishes between practices as a 'temporally unfolding and spatially dispersed nexus of doings and sayings' or 'spatio-temporal entities' and practice as performing an action (Schatzki 1996:89-90), a distinction he later refers to as the organization dimension and the activity dimension of practices (Schatzki 2001). Shove et al. (2007), like Warde (2005) summarize these two forms of practice as practices-as-entity and practices-as-performance. A terminology that will further be used in this thesis.

The practice-as-entity refers to the practice as a structured organisation, i.e., capturing how the elements and their links which specify 'how actions (including speech acts) ought to be carried out, understood, prompted, and responded to; what specifically and unequivocally should be done or said (when, where, …); and which ends should be pursued, which projects, tasks, and actions carried out for that end, and which emotions possessed – when, that is, one is engaged in the practice.' (Schatzki 2001: 101). Importantly, as opposed to practices-as-performance, practices-as-entities evidently endure over space and time. This is why they are recognisable as practices.

The practice-as-performance, the moment of doing in which the elements are integrated by people in specific situations, is slightly different each time. When zooming in on practices-as-performance, it becomes clear that this is not a uniform or constant picture: practices are 'internally differentiated on many dimensions' (Warde 2005: 138). The elements and their links (practice-as-entity) form a guiding structure, within which however, there is ample space for variety.

The practice-as-entity and practice-as-performance are so closely related that they constitute each other. Not only does entity order performance, it also arises from this same performance. The practice-as-entity is dependent on repeated performances to remain alive – Shove et al. refer to practices that are no longer performed as fossils (Shove and Pantzar 2005) – but is also transformed through them. Because the practice-as-entity persists beyond situations of performance, it ensures a certain uniformity and continuity of performances over space and time. However, while having

> 'some considerable inertia', 'practices also contain the seeds of constant change. They are dynamic by virtue of their own internal logic of operation, as people in myriad situations adapt, improvise and experiment.' (Warde 2005:140-141)

Through recurrent performances that are similar, yet more or less different in each situation, practices-as-entity are both stable and dynamic. In other words, the way the practice-as-entity is constituted at any one moment is a result of a preceding sequence of performances. This relation between practice-as-performance and practice-as-entity will become central to the discussion of the role of design in the way practices change, discussed in Chapter 6.

3.5   People and practices

People are not central in practice approaches (other than as carriers of practice), but because people play such a central role in interaction oriented sustainable design approaches, their position in practice theory will be elaborated on here. Reckwitz summarizes the role of people in practice theory as 'body/minds who "carry" and "carry out" social practices' (Reckwitz 2002a: 256). This section will first explore the concepts of body/minds and carriers, and subsequently use them in introducing the idea of careers, a concept central in understanding change in practices.

3.5.1   Body/minds

Reckwitz describes people as body/minds. To understand this somewhat curious use of terminology, it is important to know a couple of things. Practice theorists explicitly distance themselves from social theories that emphasize the life of the mind and conceptualise people as autonomous (rational) thinkers and decision makers. The human body nonetheless plays an explicit role in practice theory. In the words of Reckwitz (2002a) practices are 'routinized bodily activities'. Because these routines are learned over time through repeated performance, the body is seen as an important realm of knowledge. In Giddens' Theory of Structuration, this knowledge is present in the form of practical consciousness:

> 'practical consciousness consists of all the things actors know tacitly
> about how to 'go on' in the contexts of social life without being able
> to give them direct discursive expression.' (Giddens 1984: xxiii)

Through performance, the body becomes trained in a certain way, when knowledge about the practice becomes embodied in the practitioner. However, this knowledge is not easily verbally expressed. For example, walking is not difficult to do for most people, but exactly putting into words how to do it is nearly impossible.

    The human body is important in practice theory, both as a carrier and performer of practices. However, by describing people as body/minds instead of simply as bodies, Reckwitz seems to agree with Schatzki that there is more to practices than unconscious or subconscious bodily routine. Based on the observation that 'people can explain almost all of their actions in great detail' (whether right or not), Schatzki acknowledges the existence of mind and mental states. However, he immediately distances himself from models in which mind is conceptualized as 'a thing or apparatus that causes behaviour'. Rather, he states, 'mind is a medium through which the activities that compose a practice are *noncausally* organized'. Mental states are expressed in behaviour. Behaviour manifests or signifies them, e.g. joy in crying and belief in God in praying. These states do not inform behaviour by causing it, but by determining what makes sense to people to do' (Schatzki 2001: 50).

    Here, Schatzki explicitly pulls practices out of the corner of merely unconscious routine activity and broadens the concept to encompass all forms of human behaviour. Routine is then seen not as unconscious patterns simply repeated in different situations, but as recognizably recurrent forms of behaviour that nonetheless vary in each occurrence. Along these lines, Shove et al. frame practices as 'whatever actual and potential practitioners recognize as such' (Shove et al. 2012: 82). This notion becomes important in later chapters, where the issue of selecting and describing target practices is discussed.

3.5.2 Body/minds as carriers

Referring back to Reckwitz, people carry and carry out social practices. When taking a practice-oriented approach, the researcher will therefore view people as carriers and performers of practices. However, people are not seen as puppets acting out a pre-determined scenario. The practice-as-entity (partly) resides in people in the form of bodily and mental knowledge, but is also dependent on people performing it to remain existent. Moreover, in practice theory, it is the performer of the practice who actively integrates the elements and thereby reproduces, but also transforms the practice-as-entity. This transformation happens through variations in the practice-as-performance when people adapt, improvise and experiment, to refer back to the terms of Warde (2005), in the ever changing circumstances of daily life.

It is essential to note though that people do not *have* practices, and cannot transform a practice on their own. Although not so in common use, in practice theory it is awkward to speak about *someone's* practice, for no one has 'complete' agency or authority over a practice. In fact, Reckwitz later corrects himself by saying that 'social practices' is a tautology, for practices are socially shared inherently[4]:

> 'A practice is social, as it is a 'type' of behaving and understanding that appears at different locales and at different points of time and is carried out by different body/minds.' (Reckwitz 2002a:250)

However, 'social' does not necessarily mean social as in actual person to person interaction. A practice can be socially shared even if it is performed predominantly in private, like for example bathing or going to the toilet. Because people are linked by a 'profound mutual susceptibility' (Barnes 2001:24) they are able to sustain practices as 'oversubjective' (Schatzki 2001:6), collective achievements. Latour, as will become clear further on, offers a more materialized view on this phenomenon of oversubjectivity.

3.5.3 Careers of people and practices

People and practices are related, because practices reside in people's bodies, and are maintained and transformed when performed by people. In order to understand this concept of transformation, which is highly relevant for sustainable design, it is necessary to add a time dimension to the conceptual framework. As explained above, the idea of a relatively stable practice-as-entity that exists beyond situations of performance, makes it possible to trace a practice back in time. In practice theory, this time dimension manifests in the concept of careers.

To complicate matters, both people and practices can be viewed as having careers. As Shove and Pantzar conclude from their analysis of the historic trajectories of digital photography and floorball, 'the careers of individual practitioners determine the

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[4] which is why this thesis speaks of practice theory rather than social practice theory, although the latter might be more clear to those unfamiliar with it and is therefore used in the title of the thesis.

fate and future of the practice itself. As more or different people become involved so the meaning and experience of involvement changes and so the practice evolves' (2007: 154). Practices, over the course of their career are carried and carried out by a changing group of variously skilled practitioners, while people, over the course of their lives will carry and carry out varying sets of practices. An individual can thus be seen as 'a unique crossing point of practices' (Reckwitz 2002a: 256).

The notion that practices can only exist when regularly performed by people and the fact that they are socially shared entities implies that for any practice to exist, a certain number of practitioners is required. It does not mean, however, that this is a fixed and constant group of people. According to Shove et al. (2012: 70-71) practitioners can become recruited into a practice and will, in case of repeated performance, follow a path from novice to expert. But level of competence is not the only way to differentiate between different practitioners. Warde lists theorists and technicians, generalists and specialists, conservatives and radicals, the highly knowledgeable and relatively ignorant (2005: 138), implying not only various types and levels of competence, but also of commitment, down to the level of no commitment at all.

It has to be noted that, from the perspective of the practice, it can be carried by changing numbers of practitioners at various levels of competence and commitment. However, people are not free to take on any practice they like. The required elements of the practice need, at the least, to be available to them. This notion will be explored further in Chapter 6.

3.6   Things and practices

Naturally, things, material objects cannot remain implicit in this discussion of the implications of practice theory for sustainable design. Although materials are one of the elements of practice in this thesis, they are, like people, certainly not central in practice theory. In fact, in most strands of the theory they hardly feature at all. However, those who do recognize the role of things in practices argue that this role is important; both for the way the practice is organized and for the way it spreads and changes.

3.6.1   Constitutive and irreplaceable

Reckwitz is one of the practice theorists who has explicitly addressed the role or materiality in practices. He has done so by combining Schatzki's view on practices as nexuses of doings and sayings with Latour's idea of a 'symmetric anthropology', in which humans and non-humans are treated as equals (Reckwitz 2002b). Reckwitz explains that according to Latour, the material world 'should be understood as "artefacts" or "things" that necessarily participate in social practices just as humans do' (2002b:202). In such a view, 'both the human bodies/minds and the artefacts provide "requirements" or components necessary to a practice' (Reckwitz 2002b:212), i.e. artefacts are approached as 'active, constitutive elements in the reproduction of daily life and social order' (Watson 2008) and are placed at the same level as people.

Moreover, things are not just any-thing; they have a certain materiality. In addition to being 'interpreted' by people in certain ways, they are at the same time 'applied and used, and must therefore be handled within their materiality'. By specifying performance as performing with things, it becomes clear that things are not 'arbitrarily interchangeable'; they are 'irreplaceable, constitutive elements of practice' that 'enable and constrain the specificity of a practice' (Reckwitz 2002b). However, things do not shape practices in a strict causal way. In practice theory, interaction between person and product is viewed as 'situationally contingent', meaning that specific engagement unfolds in the 'emergent doing of practice' (Watson 2008) which is different in each situation. Along the same lines, Hand and Shove (2007) find, in their analysis of home freezing that the same object can be used for and interpreted in highly varying ways, from which they conclude that objects have a 'persistently dynamic status in daily life'.

Importantly, 'because not only *bodies* but also *artefacts* are sites of understanding', practices, according to Reckwitz, can only be adequately understood through their 'double localization: as understanding incorporated in human bodies and as understanding materialized in artefacts' (2002b: 213). In other words, (elements of) practice reside both in people and in artefacts. This point will be elaborated on in Chapter 5, where the analysis of practices for sustainable design is addressed.

Other theorists who have explicitly engaged with the material elements of practice are Shove and colleagues, who, moreover, make an explicit link between materiality in practice theory and resource consumption. Inspired by the work of Jalas (2006), they argue that one of the merits of their interpretation is 'recognition that most consumption, including environmentally significant consumption, takes place not for its own sake, but as part of the effective accomplishment of social practices' (Shove et al. 2007: 152).

3.6.2 Reproduction and transformation of practices

Besides being irreplaceable, constitutive elements of practice, artefacts according to Latour (1996), play an important role in enabling the social reproduction of practices beyond temporal and spatial limits. Because the material things handled again and again in different situations endure, he argues, artefacts enable interaction beyond face-to-face encounters. This explanation at least partly demystifies the 'profound mutual susceptibility' Barnes ascribes to people in explaining this same phenomenon of social sharing in absence of actual social interaction.

Besides contributing to the uniformity of a practice over space and time, new artefacts play a role in the transformation of practices; 'as [new] things are integrated into practices-as-performance […] so they are of consequence for the emergence [or transformation] of practices-as-entities' (Shove et al. 2007: 148). However, the relation is recursive. Things transform practices, but through integration in a practice, things also come to "'materialize' or 'incorporate' knowledge particular to that practice (Reckwitz 2002b: 212). In other words, 'designed artifacts shape and are shaped by the contexts in which they are used' (Ingram et al. 2007). Consequently, practices cannot just be shaped by introducing new products. Interaction between humans and products is situationally contingent, their status is persistently dynamic and they are co-shaped both by their designers and the collectives of practitioners who integrate them in performance.

However, this does not mean that nothing further can be said of the role of things in social change. Reckwitz's final remark that 'if *social change* is a change of complexes of social practices, it presupposes not only a transformation of cultural codes and of the bodies/minds of human subjects, but also a transformation of artefacts' (Reckwitz 2002b: 213, emphasis in original) provides a nice bridge to the role of (designed) materiality in processes of change. A topic that will be further explored in Chapter 6.

3.7   The field of practices

So far, the chapter has talked about single practices. However, Schatzki ascribes the central unit of concern in practice theory to the 'field of practices' (2001: 2), which is the total of interconnected human practices. In his words, 'practices can [...] overlap, form hierarchies, and join to compose more complex practices' (Schatzki 1996: 96).

For understanding this field of practices, it becomes important to know something about the relation between practices. As becomes clear from the explanation by Schatzki, this is not a matter of different practices simply existing next to each other. The sections below will go deeper into how practices overlap and join in what Shove et al. (2012) refer to as bundles and complexes, how they can be categorized into dispersed and integrated varieties, and how they don't simply co-exist, but mutually influence each other.

3.7.1   Bundles and complexes of practices

Practices interact in different ways. As mentioned in section 3.5, one node or nexus of practices can be found in individual carriers. Other ways in which practices interact is by taking place in the same location (e.g. the kitchen) or in sequence to each other. As already indicated by Latour, like people, artefacts have the capacity to connect situations otherwise separated in space and time. Things, through their material persistence do not only connect different performances of the same practice, they can also connect different practices. For example, the same bicycle can be an element in commuting and in leisure practices. Moreover, this connecting role is not restricted to material elements. Both skills and images can bind different practices as well. For example, skills in surfing and skateboarding also come in handy when snowboarding (Donnelly 2006), and images of cleanliness connect practices such as laundering and bathing (Shove 2003).

Shove et al. (2012: 81) categorize the various ways in which practices can be related as co-existence, such as being tied by a shared location or time slot, or the stronger form of co-dependence, forming looser practice bundles or stronger practice complexes. Cooking and eating, for example, are co-dependent and form practice complexes together with shopping and storing food. These connections between practices are not fixed. Rather, they can be viewed as 'webs of co-dependence that are not evenly arranged (but include knots, nodes, relays, etc.) continually rewoven as practices are reproduced' (Shove et al. 2012:94). For example, where chauffeuring and repairing were once tightly joined in the practice of driving (Borg 1999), they are today clearly separated.

3.7.2   Integrated and dispersed practices

Schatzki distinguishes two types of practices, dispersed practices and integrated practices. Dispersed practices are 'widely dispersed among different sectors of social life' (Schatzki 1996: 91). Examples of dispersed practices are describing, following rules, explaining, and later in Chapter 6 improvising and experimenting will be discussed as such. Dispersed practices are sets of doings and sayings mainly linked by a 'knowing how to', including knowing how to perform, recognize and judge the practice. Integrative practices on the other hand are 'found in and constitutive of particular domains of social life' (Schatzki 1996: 98). Examples are cooking practices, cleaning practices and religious practices. Dispersed practices are often but not always transformed in integrative practices and when carrying out a dispersed practice, people are usually also engaged in a dispersed one, for example explaining something within the performance of cooking.

3.7.3   Mutual influencing

When practices interact in different ways, 'lessons are learned, innovations borrowed and procedures copied' (Warde 2005: 141); practices mutually influence each other. Due to spill-over effects, a change in one practice can have far reaching consequences for other practices with which it co-exists or is co-dependent. For example, the introduction of the freezer has not only changed practices of storing food, but also of cooking, eating and shopping, and in a broader sense 'the scheduling and co-ordination of domestic life' (Shove and Southerton 2000).

Moreover, Shove et al. (2012) argue that practices do not only compete for limited resources like time (one can simply not be watching television and working in the garden at the same time), but that it is in the relations between practices that *understandings of space and time are formed*. They give the example of 'prime time', a concept formed collectively by millions of viewers, which has influenced programming and in turn affects all kinds of domestic activities such as the time household members eat – whether at the table or in front of their favourite program (Shove et al. 2012: 90).

While in this thesis focus will mainly be on individual, integrated practices, it remains important to keep in mind that these practices are always more or less closely intertwined with other practices, and that when they change this is likely to have effects beyond the practice itself.

3.8   An overview of the conceptual framework

Based on the introduction of theories of practice in this chapter, an overview can be made of the main concepts in the framework:

- Practice theorists explicitly position themselves at the middle ground between the opposing theoretical stances of explaining human behaviour through models of rational individual action on the one hand, and collective normative consensus on the other.

- Rejecting the idea of general explanations, practice theory offers a framework for giving a 'general and abstract account' on the topic of study.
- Practices consist of interrelated elements that can be grouped as stuff, skills and images. Stuff includes human and non-human elements, skills can be viewed as distributed between people and things and images explicitly incorporate meaning as formed in practices.
- Constellations of elements form relatively stable and recognizable practices-as-entity that are reproduced and transformed when elements are integrated in different situations in the practice-as-performance.
- This recurrent relationship gives practices both their stability and inherently dynamic nature.
- People figure in practices as body/minds, carriers and performers. Through repeated performance, practices become carried as bodily *and* mental routines, but not without reflection; people adapt, improvise and experiment.
- People cannot *have* practices, practices are inherently shared, collective achievements.
- Practices can be viewed as having a career that develops over time, involving various numbers of practitioners at various levels of commitment and competence.
- Practices (or the elements of practice) reside both in people and in artefacts.
- While things are irreplaceable, constitutive elements of practices, they both shape and are shaped by these same practices.
- In the field of practices, practices dynamically relate to each other in looser bundles or stronger complexes by sharing carriers, locations, images and skills and can be viewed either as dispersed or integrated.
- Due to spill-over effects, practices mutually influence each other, moreover, understandings of space and time are formed in the relations between practices.

3.9   Conclusions

Without having explored its implications for approaches in sustainable design so far, it becomes clear that practice theory offers a theoretical basis that is fundamentally different from the theories that interaction-oriented approaches in sustainable design build on. Most basically, human action is in interaction-oriented approaches viewed as behaviour that is determined by factors in causal models, while in practice-oriented approaches behaviour is viewed as performances of practices that are governed by an entity. This entity, however, is not determining the performance. Rather, it both guides and is formed and maintained by the collective sum of its performances. What this shift in ontology means for the way sustainable design is organized and whether this leads to a higher effectiveness in reaching its goals is something that is further explored in this thesis. This exploration starts with a review of previously published examples of design approaches drawing on practice theory. Chapter 4 assesses both the strengths and limitations of these approaches.

Implications of Social practice Theory for Sustainable Design

4 Practice-oriented design

4.1 Introduction

As mentioned in Chapter 2, this thesis in not the first study situated at the touching point of practice theory and design research, and even in the area of sustainable design other researchers have pondered over the question of how to 'operationalize' a practice-orientation in design projects.

This chapter first offers an account of the origins of practice-oriented design, after which it offers a critical review of publications, published before the start of the current research, in which a practice-oriented design approach is elaborated on and applied in a design project. After providing an overview of selected publications, their varying ways of interpreting the implications of a practice theoretical approach to design are compared. The chapter will close by identifying areas of further research to be addressed in the rest of this thesis.

4.2 How practice-oriented design started

The term 'practice-oriented design' was first launched in the 'Designing and Consuming: objects, practices and processes' research program (2005-2006). The program was designed and executed by a multidisciplinary team led by sociologist Elizabeth Shove. Shove et al. (2007) introduce practice-oriented design against what they characterise as two dominant working understandings in design: product-centred design and user-centred design. Where product-centred design incorporates the idea that designers can embed economic, ergonomic or semiotic value in objects. In user-centred design, value is viewed

as residing in the relation between people and things, rather than in things alone. In contrast to these approaches, practice-oriented design takes practices as its unit of analysis and inquiry and focuses on understanding and influencing the evolution of practices over space and time. Value is viewed as emerging in practice and as varying from one setting to another. According to the authors, practice theory implies that 'designers have an indirect but potentially decisive hand in the constitution of what people do' (Shove et al. 2007: 134). Moreover, they make a link to sustainable design by arguing that 'most consumption, including environmentally significant consumption takes place not for its own sake, but as part of the effective accomplishment of social practices' (Shove et al. 2007: 152).

The most concrete example toward application of practice theory in design from the Designing and Consuming program is the 'POPD Manifesto' (Shove and Watson 2006), in which POPD stands for Practice Oriented Product Design. It is a one page provocative pamphlet used in a series of workshops with sociologists and designers. In its eight 'POPD tenets', the manifesto describes the type of mind-set typical for POPD as taking a 'perspective beyond single products and individual users towards practices as the basic unit of analysis' and recognizing that products, designers, consumers, needs, values and practices are related and constantly evolve under each other's influence. The main methodological implication is that 'POPDers study practices, now and over time' through 'large scale data sets, statistics on the use of time, money and energy, market research and detailed qualitative exploration of situated practice'. In short, the manifesto offers designers a complex worldview in which practices are the fundamental unit of society. This worldview implies a form of analysis that is both broad and continuous, with the aim of 'understanding the dynamics of practice' and 'identifying points for intervention'.

Although a promising point of departure, the book chapter and manifesto do not offer designers something to readily apply in a design project. The work of Shove and her multidisciplinary team discusses what the role of design is in a practice-oriented view. It also builds a strong point in explaining why design should take a practice-oriented approach, especially when aiming for sustainability. However, understandable from their position in the social sciences, the question of how design should take a practice-oriented approach is addressed only superficially. However, in order to perform practice-oriented design, besides a different mind-set, designers require novel or adjusted design approaches and methods applicable in the context of design projects.

4.2.1   Overview of selected publications on applying practice theory to design

Initially triggered by the ideas, workshops and writings of Shove and colleagues, practice theory has been picked up by several design researchers. An intensive search for references to practice theory in design literature resulted in a collection of fourteen publications. The criteria for inclusion in this review were that the articles had a focus on product development from the perspective of design, references to practice theory, elaboration on a design approach and the use of a case study, preferably with outcome descriptions. Grouped together by author, a list of eight (groups of)

	Publications	**Author or author group**	**Project topic**
1	Blyth and Roberts (2005); Roberts (2005); Prendergast and Roberts (2009)	Roberts	Tongue cleaning Health and seniors
2	Korkman (2006)	Korkman	Family cruise
3	Julier (2007)	Julier	iPod community
4	Munnecke (2007)	Munnecke	-
5	Hielscher et al. (2007); Hielscher et al. (2008); Fischer and Hielscher (2008)	Hielscher	Hair care Plastic waste
6	Bakker, De Jong and Scott (2008); Scott (2008); Scott et al. (2009)	Scott	Bathing
7	Pettersen (2009)	Pettersen	Laundry care
8	Jegou et al. (2009)	Jegou	Heating the home

Table 4-1 Overview of publications on practice theory in design projects.

authors emerged. An overview of these authors and the topics of the described design projects are provided in Table 4-1, in order of the author's first publication. These authors have engaged with practice theory for different reasons. Although in most cases multiple reasons were mentioned, generally two categories can be distinguished. Roberts, Korkman, Julier and Munnecke primarily focus on the potential commercial benefits (from a business perspective) of a practice-orientation in design, like 'creating new innovation ideas', 'preventing market failure' and 'obtaining better customer insights'. The other four authors – Hielscher, Scott, Pettersen and Jegou – primarily express ideological objectives (beneficial from a societal perspective), with a focus on environmental issues, such as 'rising household resource consumption'.

The theoretical descriptions the authors offer of practice theory vary in level of detail, from a short mention of several concepts to an elaborate explanation containing all the concepts introduced in Chapter 3, but by and large they convey the same message. Differences between the papers mainly lie in the methodological implications of practice theory for design approaches that these authors elicit. These differences lie in the ways in which information is gathered on the practice and the ways in which this information is used to identify opportunities for design. Approaches are evaluated against the tenets set out in the POPD manifesto and the concepts introduced in Chapter 3. Specifically, the review evaluates to what extent 'understanding of the dynamics of practice' is achieved and what the potential for sustainable design is of the 'opportunities for intervention' that are identified. In the analysis of approaches, a distinction emerged between approaches analysing current situations, aiming to understand how things are and approaches that explored potential future situations, aiming to get an idea of how things could be. This distinction structures the present analysis of different approaches in these papers set out below.

4.3   Analysing current practices

While the authors take a practice-oriented approach for various reasons, these reasons all come down to the capacity to approach consumption or use as a complex and dynamic phenomenon. The approaches themselves show large differences however. In describing them, a distinction can be made between exploring situated practice and exploration of the practice over time and space.

4.3.1   Exploring situated practices

A recurring element in six of the eight approaches is what the POPD manifesto refers to as the qualitative exploration of situated practice. This is done in various ways. Three of the studies involve in-situ observation by the researcher of respectively the internet usage and modes of learning of elderly (Roberts), family cruise practices (Korkman) and iPod use in a community of teenagers (Julier). These observations are supplemented with interviews with the observed. Korkman in particular elaborates on his immersive ethnographic fieldwork on the family cruise. Because hair care is a private practice, Hielscher (in Hielscher et al. 2008 and Fisher and Hielscher 2008) shifts focus from observations to interviews and describes the gathering of data on situated practices through in depth interviews in peoples own homes. For similar reasons, two studies, by Hielscher (Hielscher et al. 2007) and Scott explore the details of situated bathing and hair care practices, but do not 'go into the field'. Both obtain their data through cultural probes; playful workbooks or -packages with tasks of self-observation and reporting. Their views on the role of the probes slightly differ. Hielscher refers to cultural probes as a source of inspiration for both the designers and participants as advocated by Gaver (1999). Scott on the other hand, places emphasis on the probe as supporting participants' self-analysis and the co-design aspect of engaging them in a design process, which is more in line with the work of Mattelmaki (2008). Finally, Jegou combines approaches and gains an image of the way households deal with heating their home through e-mail interviews, self-observation and visits to these households. Viewed over all publications, participants were individuals, households, families and communities and varied in number from 3 to 16. The duration of the exploration ranged from several hours to an (intended) 'one year engagement' (Prendergast and Roberts 2009).

Techniques of observation, interviewing, cultural probes and home visits are existing methods, not specifically developed for these studies. What makes these approaches practice-oriented is the unit of inquiry. Rather than the product or the user, the practice is – or is claimed to be – the main unit of analysis. This difference manifests itself as an interest in the different elements of the practice (images, skills and stuff), an inclusion of multiple products and people and a turning away from looking into people's minds, towards a main interest into what people do and the rationales they offer about this. However, there is a wide variety in focus between the authors. Julier for example, starts out with and more or less centres on a product, the iPod and Roberts seems to focus more on 'users' (elderly) than on a particular practice. Similarly, Korkman explores different

practices of families on a cruise, thereby centralizing the families. As will be explained further below, when exploring situated practice, there seems to be a challenge in capturing the practice-as-such, beyond the familiar units of the people and artefacts that carry it.

4.3.2   Exploration of practices over time and space

In contrast to the elaborate attention paid to situated practice, attention to other types of data for 'tracing the practice over space and time', as prescribed by the POPD manifesto is marginal in the papers. Exceptions are Munnecke, Hielscher et al. (2008) and Scott. Munnecke, in his 'deep-dive' approach gives diving into a practice's historic development a central role in order to extrapolate its dynamics to future scenarios and thus an 'overview of future innovation opportunities'. However, he does not work out his approach in a case example.

Both Hielscher and Scott are more specific and describe how they gathered data from a wide variety of sources. Hielscher, for example, combines in-depth interviews with 24 women and 12 hair care experts with analysis of historical work on hair care. She deliberately traces the elements of the practice – images, skills and stuff – and their co-evolution back in time. Because the paper focuses on resource consumption for hair care, starting points are rationales of interviewees for washing or not washing hair. The search starts with an exploration of ideas of what is clean and consequently of what constitutes dirt. Ideas of dirt that exist among practitioners are then compared to expert knowledge regarding the physiology of the scalp. After concluding that images of 'good' and 'bad' grease have changed over time and that ideas of clean today have little to do with the health hazards that routines of frequent washing were initially set out to conquer, the paper goes deeper into different ways of dealing with grease and the products used in the process.

Although their topics are closely related, the approach Scott takes to the study of bathing practices is quite different. In her thesis, she first devotes a section to the quantification of bathing impacts, distinguishing between water use, energy use and product use, drawing on a range of statistical reports. Like Hielscher, she goes deeper into what she calls 'the biology and chemistry of bathing-as-cleaning', not by talking to experts, but by consulting the website of a large cosmetics producer. This exploration leads her into the world of surfactants, sebum, follicles and emollients. Next, she uses a variety of literature sources (including Hielscher) to paint a culturally diverse overview of the histories of bathing and current trends, concluding for example that bathing in the past 50 years has changed from a two-weekly bath to daily showers. Finally, she devotes a section specifically to trends in bathroom technologies for which bathroom supplier websites are an important source.

Because the history of a practice generally dates back much further than the lives of individual people or things, it seems to be useful for breaking free from the product or user bias. Tracing a practice back in time reveals the sequence of historical events that have formed the ideas of what is normal, good and appropriate today, and how they have co-evolved together with a range of different human and non-human carriers.

Korkman confirms this idea in a footnote mentioning that including an historical analysis 'would most certainly have given the practice description more depth' (Korkman 2006: 93). A similar effect seems to be sorted from comparing practices in different cultures. Moreover, this form of looking beyond or behind the taken for granted is also present when analysing the 'science' of bathing and hair care. The physiology of the scalp and skin is not something that can be directly observed or that people will talk about in interviews. Nonetheless, they play a determining role in the practices. In conclusion, exploring a practice over space and time seems to be a possible answer to the challenge of identifying the practice-as-entity behind the people and things in which it resides. However, there is little guidance in design literature, so far, on the type of data that is useful to include in this form of analysis and its narrative, and how it can be gathered.

4.4 Exploring future practices

Gathering data on the current practice and its evolution over time is, in some of the projects merged with the generation and evaluation of ideas about how the practice could or should be in the future. These future oriented ways of approaching practice analysis are in addition to the starting points offered in the POPD manifesto.

4.4.1 Disruption as a means of changing practice (as performance)

A concept that recurs in several approaches is that of 'interfering' in the situated practice. Jegou, Hielscher and Scott are deliberately 'disrupting' the practice, with different purposes. One purpose of disruption is to gain insight into the composition of the elements of practice. Hielscher expresses this mechanism as creating disorder – or with reference to Reckwitz, generating potential 'crises of routines' (Reckwitz 2002a: 255) – with the aim of provoking routinized behaviour to 'rise to a state of consciousness' (Hielscher et al. 2007: 8). Scott uses simplified concepts from practice theory, like the images, skills, stuff visual to frame exercises for participants to 'deconstruct' their bathing practices (Scott 2008: 44). In addition, she challenges her participants to explore bathing of yore through interviews with their parents or grandparents.

Another purpose for interference, explicitly mentioned by Jegou and Scott is to gain insight into possible changes in the practice – rather than understanding the current practice better. Jegou mentions that their 'co-design process', including propositions of different ways of organizing ones domestic environment, functioned as a 'toolkit to question domestic practices, to take a distance from them and enable the families to re-invent progressively their daily ways of living' (Jegou et al. 2009: 28). Scott mentions something similar. In her study 'practice-oriented ('discursive') triggers' were used to 'stir up creativity in practice' and eventually 'to help people reinvent ordinary practices' (Scott et al. 2009: 5). Such a discursive trigger was for example a story of a group of women who had stopped using shampoo.

4.4.2 Integrating new elements in performances

Moreover, in all three studies participants were challenged to actively integrate new elements in their daily routines. Hielscher describes the probes used in their study as objects that 'participants had to use during their everyday routines of hair care' (Hielscher et al. 2007: 6). Jegou gives mock-ups of products supporting their idea of semi-manual thermal regulation to the families to try out at home. Scott did not offer specific new elements, but challenged participants to come up with and do experiments in their everyday bathing routines, thus leaving the selection of novel elements up to the participants.

The approaches to explore possibilities for change show similarities to participatory design and action research. Participatory design involves future users in the design process of new products; i.e. the product is central in the project. Action research addresses 'social system change through action' (Foth and Axup 2006) and is thus focused on processes and more open as to what elements in the system require change. Both, like the approaches in the studies are iterative in nature, involve subjects as collaborators and may involve researchers as participants. While Hielscher and Jegou seem to stay closer to participatory design and thus to a focus on products, Scott emphasizes the role of the community as a breeding ground for change. The small community of participants forms a (temporal) justification to deviate from existing norms about for example frequencies of bathing. This could be regarded as action research in which the 'social system' is approached through tinkering with instances of the performances of specific practices. A limitation of these approaches is that they all tend to focus on performances, without making reference to changes in the practice-as-entity.

Something of a designer's mind-set seems to add to practice-oriented design is a future orientation. The idea of probes developed in the design field turn out to be a potentially useful way of unravelling those elements of practices that have become so taken for granted that they become obscured from the eye of the researcher. Moreover, the idea of performing future configurations shows potential in taking practice-oriented design beyond a thorough understanding of the present, to what could be in the future. The next section will go deeper into the types of future opportunities that can thus be identified and their value for sustainable design.

4.5   Identifying opportunities for change

While gathering of data leads to an understanding of the dynamics of practices, the main goal for design is to identify points for intervention. As explained by Shove et al. (2007), a practice-oriented designer conceptualizes value in a particular way, not as something that can be provided, but as emergent in practice. This section starts with an explanation of this difference. It elaborates on the work of Korkman in some considerable detail, because it usefully illustrates some of the tensions that can occur when merging practice theory with ideas of value common in the field of design, or in this case service development. This analysis is followed by two examples of what the author considers as promising opportunities for sustainable design that have resulted from practice-oriented design projects.

4.5.1   Improving the value of services by analysing practices?

In his ethnographic study of family cruise practices, Korkman looks for ways in which the cruise provider can 'improve the value' of the service offered to the families. He claims that service providers should look beyond the improvements customers suggest in interviews and perform analysis of the practice by observation of the actual actions of the customers. His idea is that this type of approach can find opportunities for improvement that customers are not consciously aware of themselves. To do this, he unravels the family cruise into different practices and identifies 'problems/disjunctures' in each. His proposed approach may be novel and valuable for service development, but when viewing it from a practice theoretic perspective, some tensions arise.

One main tension lies in the idea of problems in practices and the related concept of improvements. Korkman observes the actions of his 'subjects', labelling them as practices, but judges their behaviour and identifies problems from a frame of reference that lies outside of these practices. What then remains as 'the practice' seems to be merely actions that happen in the specific setting of the cruise ship. In describing the 'practice of buffet' for example, Korkman uses an implicit idea of 'normal' dining (in which all family members sit at the table throughout the meal and courses are eaten at the same time, in a 'proper' sequence) as a frame of reference to judge the actions of the family members. He concludes that although some families

> 'are successful in keeping the practice together and actually perform a form of "dinner" with the family'. 'It is very hard to have this kind of easy pace of dining, due to the fact that the practice does not support it.' (Korkman 2006: 96-97)

In the view of Korkman, families' 'actual need' is to 'dine in an easy pace', while the practice of buffet dining seems, in his observations, not to allow this. He even literally refers to the practice of buffet dining as 'strange' (Korkman 2006: 95). However, when viewed from its own internal set of meanings and rationales, the practice of buffet dining is an acceptable way of dining for the families, simply because it is performed. In fact, a quote by one of the family members indicates that it is even an essential element of taking a cruise

> 'It is important to eat at least once at the buffet, because that is the way cruises are carried out.' (Korkman 2006: 93)

The freedom of getting your own food at your own time apparently compensates for a way of dining that is somewhat more disorderly than having a meal in which everyone remains seated at the table gets their dishes at the same time and in a fixed sequence. Moreover, disliking the buffet might even be part of the practice, as Korkman notes 'a number of families express rather straightforward dislike towards the buffet, but nevertheless most of them use it' (Korkman 2006: 94).

Another example confirms how Korkman dismisses the internal logic of the practice. He relates what he refers to as a 'rather extreme story', which in his view explains 'why the buffet restaurant does not work for families with smaller children' (Korkman 2006:

94). It is a story of how two parents eat in the buffet restaurant with their children, while dividing tasks and eating in shifts. Contrary to what Korkman aims to show with the story, it in fact explains how, although not in the 'orderly way' preferred by Korkman, families with smaller children do make buffet dining work. Moreover, labelling this type of performance as 'rather extreme' might stem from Korkman's own, non-parent (Korkman 2006: 77) perspective.

What this example highlights it that the idea of 'improving the value' of a practice is a tricky one. In a practice theoretic view, because the practice exists – is performed repeatedly by a certain group of people – it somehow works the way it is. The practice, as carried by the collective of its practitioners, has a logic of its own that exists as a shared understanding between these practitioners. It therefore makes little sense to 'evaluate' a practice (buffet dining) using standards from a different practice ('normal' dining).

4.5.2 Problematizing existing practices to create change

A different approach to value is proposed by Roberts. He states that there are no problems or consumer needs that simply exist 'out there' waiting to be found and met, but that 'needs' can be constructed. To illustrate this point, he gives an example of tongue cleaning:

> 'Consumers in the UK may not currently claim a great need to clean their tongue. Thus there is little demand for a tongue cleaner of the sort routinely used in India. Start however communicating that bacteria on the tongue is a major source of bad breath; introduce a new innovative thing called a tongue disinfector and we may find that we have a got a new product on the shelf meeting a new need.' (Blyth and Roberts 2005: 13)

According to Roberts, the success of such an innovation needs the 'problematization' of the existing situation. For example, when introducing the tongue disinfector, bacteria on the tongue that are currently not considered problematic, are problematized in communication around the new product, for example as sources of bad breath. In short, as opposed to Korkman, Roberts does not suggest that commercial organisations should look for problems, but create them. It can be argued that this is what Korkman actually does; by 'ignoring' the internal logic of the practice of buffet dining, he is problematizing it as strange, extreme, disorderly and hasty.

While the point of view of Roberts resonates with the with the idea of finding or creating opportunities for design interventions and provides a way out of the problem-solution paradigm that is so dominant in design, creating a new practice of tongue cleaning does not sound like a way to reduce household resource consumption. However, the idea that 'material artefacts configure (rather than simply meet) what consumers and users experience as needs and desires' implies that 'those who give them shape and form are perhaps uniquely implicated in the transformation and persistence of social practice' (Shove et al. 2007: 134), also when this concerns desirable transformation in the direction of lower resource consumption. What this approach

shows is that not only should a practice be judged according to its internal logic, i.e., its own ideas of what is good, normal and appropriate. These ideas of what is good, normal, desirable or needed are constructed and subject to change, partly under the influence of new product development and the way in which these products are positioned. Therefore, the following section investigates how Hielscher and Scott have used a practice-orientation to identify opportunities for sustainable design.

4.5.3   Project outcomes, sustainable design and transforming practices

Hielscher finds opportunities for desirable change in the combination of her historical review of the elements of hair care practices, interviews about current ways of dealing with hair care and expert knowledge on grease and the scalp. This exploration of hair care from different angles reveals that ideas about 'acceptable' quantities and types of dirt and ways of detecting and dealing with it, are important dimensions for resource use, and that these ideas change over time. As a direction for sustainable design, she suggests that design might engage with ideas of 'good' and 'bad' grease, for instance by making oils naturally produced by the scalp more acceptable. This would be a way to reduce frequencies of washing hair and thus the resource requirements of this practice. Hielscher clearly approaches the practice from its internal logic and uses insights on the historic dynamics of this logic to identify pathways for future desirable change. Thereby acknowledging and working with the idea that needs; like the need to remove natural grease from the skull, are subject to change.

Hielscher also identifies the mechanism of problematization highlighted by Roberts. She mentions that in hair care, advertising has contributed to the problematization of conditions like 'dryness' or 'lack of shine'. However, directly following these observations, she illustrates the use of these same mechanisms for the purpose of encouraging less resource intensive techniques for cleansing:

> 'if technology can supply synthetic substances that 'do the
> job', the design and marketing of those substances can also
> define what the job is.' (Hielscher et al. 2008: 11)

For example, spreading natural grease rather than removing and replacing it. Although not offering concrete product examples, Hielscher does propose directions for sustainable design. A focus on practices leads her to the identification of relations between images – ideas of what are acceptable levels of grease – and frequencies of washing. The historic development of the practice demonstrates that ideas of good and bad grease are changing over time, partly under the influence of advertising and new products. Furthermore, exploration of hair care practices of the past reveals ways of hair care that were less resource intensive than those of today. These insights imply that less resource intensive ways of hair care are possible, but that a 'reconceptualization' of what is considered normal – such as normal levels of grease in hair – can be promoted

through the 'right' mix of advertising and products. These include for example the (re-) introduction of natural-bristle brushes and skills of spreading natural grease through hair. Scott follows a similar approach, but goes a bit further in working out directions for design. In addition to (self) analysis of current bathing routines, she asked participants to experiment with different ways of doing bathing at home. Thus learning something about the complex social processes involved in this type of change. From analysis of the current practice and the historic development of its elements, she identifies the connection between flowing water and luxury as one of the problematic aspects of European styles of bathing; a connection that is currently maintained, confirmed and even strengthened by trends in the bathing market. One of the design opportunities that follow from the analysis of Scott is a slow bathing concept. This idea or intervention tries to shift the relation between luxury and flowing water towards concepts of retaining water and heat in connection to for example gentleness and relaxation.

Notably, like Korkman, Scott here uses a frame of reference that lies outside of the logic of the practice. Namely, the idea that resource consumption in bathing should be reduced, something that isn't necessarily shared by most practitioners. In fact, this is also present in the work of Hielscher who judges common frequencies of washing hair as ' too often' from a resource consumption point of view. When taking a practice-oriented approach to sustainable design, it is important to be aware of this normative frame of reference used when approaching practices.

When evaluating the potential effects of these outcomes on household resource consumption, it is not possible at this point to quantitatively assess what they may be. What can be argued is that the ideas resulting from the practice-oriented approach taken by Hielscher and Scott indeed differ from examples with similar aims available today. Efforts for reducing the resource consumption involved in body washing have resulted in the development of technologies like low-flow showerheads, recycle showers and the behaviour oriented timers for use in the shower that aim at making people take shorter showers (ISH 2009). All assume the 'need' for showering, and none address shower frequencies like Hielscher or consider alternatives for the paradigm of flowing water like Scott. However, before being able to say something about the potential of such alternatives to spread and lead to actual reductions in resource consumption, further research is needed.

4.6   Conclusions and directions for further research

From the review of design approaches and projects drawing on theories of practice, conclusions were drawn that make a distinction between taking practices as a unit of analysis and taking practices as a unit of design.

When looking at implications for taking practices as a unit of analysis, it can be concluded that the isolated analysis of situated practice that seems to be the first response of designers makes identification of the practice-as-entity – beyond its manifestations in performances, people and artefacts – challenging. For understanding its dynamics, a broader analysis of the practices' history and cross-cultural diversity has

proven to be essential. A structured approach to this broad form of analysis is so far lacking, and therefore forms an area for further research. This topic will be addressed in Chapter 5 through the question:

> What does it mean for approaches to sustainable design to take practices instead of interactions as a unit of analysis?

From the analysis of approaches, a distinction emerged between understanding current practices and exploring future practices. A design orientation is inherently future oriented and this view on practice-oriented design has resulted in two methodological avenues that were not present in the POPD manifesto. One is the interference in existing practices (as performances) through probes, the other is active experimentation with what could be viewed as possible future practices. The potential of these designerly, future oriented approaches has so far been explored only superficially and will be the topic of Chapter 6. The question addressed here will be:

> What does it mean for approaches to sustainable design to take practices instead of interactions as a unit of design?

A practice-orientation does not only imply gathering particular data in particular ways, it also has implications for the ways in which opportunities for design are identified. While practice theory acknowledges that practices have their own internal logic (inertia), it also highlights the fact that needs are made and subject to change, partly under influence of products and their positioning. This offers opportunities for design to contribute to forms of change at a scale far beyond tinkering single interactions. All the while, the practice-oriented designer should be aware that the idea that household resource consumption should be reduced is a normative framework that is not necessarily part of the logic or sense of the practice.

While showing potential for large scale reductions in household resource consumption, the opportunities for intervention highlighted in the publications that were reviewed have not been worked out. For further exploring this potential, Chapter 7 and 8 will describe empirical projects on two divergent topics – bathing and staying warm at home – that provide more insight into the potential effects of opportunities for design on household consumption that are highlighted by a practice-oriented approach. It has to be noted that these empirical projects are not merely cases in which the proposed approach has been applied. Rather, consistent with the research through design approach taken in this thesis, the proposed approach has both been developed through and is illustrated by these empirical projects.

Part II
Proposed approach

Part II, consisting of the Chapters 5 and 6, presents the main results of the research and consists of an explanation of the proposed practice-oriented design approach. The approach is divided into a model for taking practices as a unit of analysis (Chapter 5) and a model for taking practices as a unit of design (Chapter 6). Methods for analysis aim to gain understanding of existing practices in order to inform and inspire design and find opportunities for change. Methods for design aim to generate possible less resource intensive reconfigurations of practices.

   It is important to explain that the order of presenting the proposed approach before the empirical projects is not chronological. Rather, the recommended approach and models were developed through and emerged from reflection on the empirical projects underlying Part III. The reason for positioning the empirical chapters after the methodological ones is because in this thesis, materials from the empirical projects are used to illustrate how the proposed approach could work.

   The resulting recommendations are specifically targeted at (product) designers embarking on a sustainable design project and meant to offer useful guidance for those interested in, but (relatively) unfamiliar with practice-oriented design. The recommendations contain a considerable amount of detail. This level of detail is meant to bring across as much of the insights – gained from several years of experience through and careful reflection on the empirical projects – as possible. It does not mean, however that the proposed approach has to be conducted exactly as described. In practice theoretic terms, the description represents a possible performance of practice-oriented design that intends to invite a wide variety of subsequent performances.

5 Practices as a unit of analysis

5.1 Introduction

Chapters 1 to 4 have outlined the (prescriptive) knowledge gaps that lie at the touching points of practice theory and sustainable design. After first exploring the basic implications of taking a practice-oriented approach, this chapter goes deeper into the topic of taking practices, instead of interactions, as a *unit of analysis* in sustainable design. As explained in Chapter 4, other authors have addressed this topic, but they have mostly limited themselves to analysing situated practice. Those who have executed elaborate forms of analyses by tracing practices over space and time have done so in various, but so far only context specific ways. Building on this earlier work, the current chapter proposes a more generalised approach to analysing practices for sustainable design.

The chapter starts with a slight elaboration of the conceptual framework offered by practice theory that was found to be important for integration of the theory in a design context. The core of the chapter, formed by Section 5.3, is a description of the proposed practice-oriented analytic approach, which consists of four related steps for taking practices as a unit of analysis. Partly, these steps make use of existing literature to obtain their data, but this needs to be supplemented with empirical data. Because there are many similarities between the challenges and ways of gathering this empirical data several steps, the chapter brings them together in a separate section on gathering empirical data when analysing practices in the context of sustainable design.

5.2   Practice theory enhanced for design

Practice-oriented designers study practices. As explained in Chapter 3, a practice (as entity and as performance) consists of the elements images, skills and stuff and their links. When studying practices, the aim is to get an overview of these elements and the ways in which they relate. In other words, studying practices means fleshing out the model in Figure 5-1.

Through experiences in specific projects, it became clear that the existing conceptual framework offered by practice theory, as presented in Chapter 3, did not always offer the footing required for the development of a practice-oriented design approach. Therefore, a slight adjustment is proposed, which nonetheless builds on existing literature.
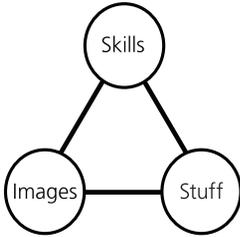
Figure 5-1 A practice that has not been analysed.

5.2.1   Practices as groupings of elements and multitudes of links

Zooming in on the practice as a constellation of elements: images, skills and stuff that are linked together, this thesis introduces an adjustment of the model used by Shove and Pantzar (2005) by visualising the elements as *groupings of elements* and the links as a *multitude of links* (Figure 5-2). This adjustment is useful for several reasons.
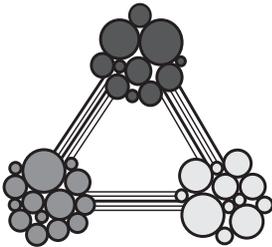
Figure 5-2 A practice as a constellation of groupings of elements, interconnected through a multitude of links.

5.2.2   Performances as partial manifestations of entities

First, it helps to clarify the important distinction between practice-as-entity and practice-as-performance. When analysing practices, it is possible to study one particular performance and describe it in terms of the images-skills-stuff model. However, a single performance is only one manifestation of a practice-as-entity. The entity contains many other varieties of performances. For example, taking a shower after sports, or before a date are both normal forms of showering, just like turning up the thermostat or putting on a jumper are widely occurring ways of staying warm at home. However, although they are manifestations of the same practice, each performance integrates a different set of

elements. All these elements and their links *together* form the practice-as-entity. So for example, although rarely deployed in the same performance, images of refreshment and of getting warm are both part of the practice of showering. Figure 5-3 illustrates this distinction between entity and performance using the refined images-skills-stuff model.

Practice-as-entity   Performance 1   Performance 2
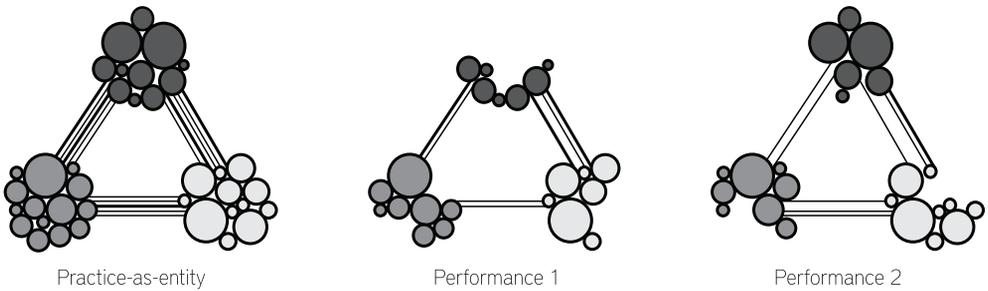
Figure 5-3 The practice-as-entity contains all elements and links that occur in the variety of performances it organises (note: it is usually more than two performances that make up an entity).

5.2.3   More and less essential elements and links

Second, what this form of visualisation also highlights is that some elements and links can be viewed as more core or essential to the practice than others, namely, when they occur in many or all performances (Figure 5-4). For example, bathing practices always involve water, and practices of thermal comfort, at least in the Netherlands, generally involve space heating. Similarly, some links may be stronger than others. Links that are made in a similar way by all practitioners may be more difficult to break than links that are more ambiguous. For example, the link between a bath and relaxation is often made, while the link between jumping up and down and getting warm was made only once, by a little girl in the staying warm projects.

Practice-as-entity   Performance 1   Performance 2
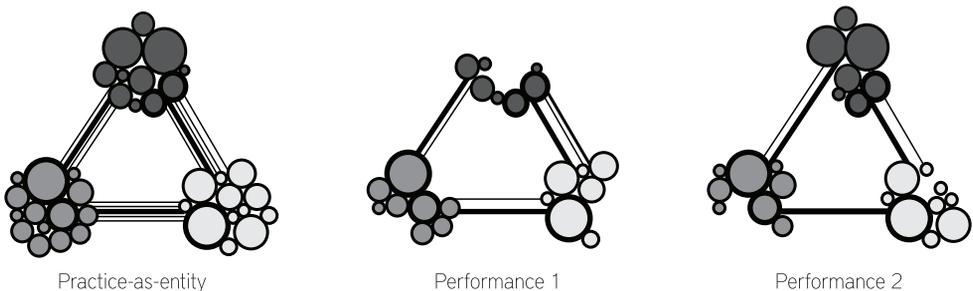
Figure 5-4 More and less essential elements/more and less strong links (adjust figure of entity).

5.2.4   On accessing the practice-as-entity

Finally, it is important to realise when studying practices that the practice-as-entity, which is the object of study, can only be studied indirectly. As explained above, the practice-as-entity only partly manifests in each single performance. Moreover, as Chapter 3 has explained, it exists or resides in the collective of body/minds and artefacts (people and things) that carry the practice. There is thus not one place, instance, person or artefact that can represent the entity as a whole. Instead, a designer interested in the practice-as-entity has to rely on various sources of inherently partial knowledge. While the following section will zoom out from the details of elements and links, Section 5.4 will return to the challenges involved in unravelling practices(-as-entity).

5.3   A model for taking practices as a unit of analysis

In a sustainable design context, the primary goal of studying practices is identifying opportunities for deliberate intervention that can achieve or facilitate change towards configurations with lower levels of resource consumption. In this respect, the disposition of a designer conducting research is basically different from that of a social scientist, whose main concern is to gain understanding of something. This does not mean that the designer does not strive for understanding, but understanding is not the end-result; it is required for the identification of opportunities for intervention.

Understanding in itself, however, does not automatically lead to the identification of opportunities for intervention. Although opportunities for intervention can be identified through a (seemingly) ad-hoc process of data gathering and analysis, as illustrated for example by Hielscher (2008) and Scott (2009), this section proposes a particular framework for structuring the search. The model is expected to make practice-oriented design more accessible for designers, to make the approach applicable beyond the specific projects it has emerged from and, in line with the long tradition of models in design, is argued to improve the chances of success in the identification of feasible directions for further exploration (Buijs and Valkenburg 2000). The model, visualised schematically in Figure 5-5, contains activities (circles) and intermediate results (squares). The model's different parts and their relations are explained in detail below, together with recommendations on collecting the required data. An exception is made for gathering empirical data, which, because of commonalities between the different forms of practice analysis in the model, will be addressed in Section 5.4 separately.

Framing the target practice

Before going deeper into the model, some attention is needed for the starting point of the analysis, which assumes a certain selected target practice. Selecting a target practice depends on the context of the design project. However, since the framing of the target practice forms an important and possibly determining part of the process, some observations from the empirical projects are offered here.

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│ Selected target  │
│    practice      │
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    │ Quantify │
    │consumption│
    │indicators│
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│history and target level │
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    ╱          ╲
╭────────╮   ╭────────╮
│ Trace  │   │ Explore│
│historic│   │similar │
│ career │   │practices│
╰────────╯   ╰────────╯
     ╲         ╱
     ╭──────────╮
     │   Map    │
     │the target│
     │ practice │
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│ desirable change │
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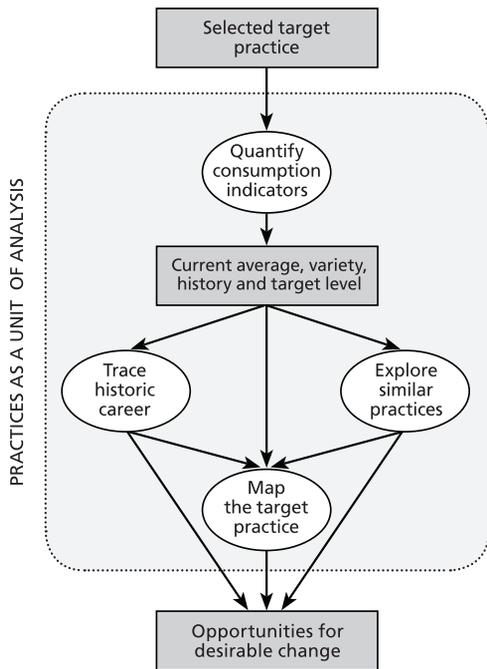
Figure 5-5 Model for taking practices as a unit of analysis and identify opportunities for intervention in a selected target practice (circles represent activities, squares intermediate results)).

First, it is recommendable not to frame the practice too narrowly. In the bathing projects for example, when looking at statistics on water consumption and similar studies within sustainable design, framing the target practice as 'showering' would have been the most obvious choice. However, the choice to approach it from the somewhat broader category of bathing made by Scott (2008), has from the onset opened up the mind-set of those involved towards alternatives for the resource intensive shower paradigm.

Secondly, counteracting the first recommendation, the target practice should not be framed too broadly. Household practices like bathing and staying warm, but also others like cooking, cleaning, sleeping, dressing and receiving guests, are so widespread that they are carried by a large percentage of people, if not all. For the proposed approach to work, the framing should be specific enough to isolate a sub-group of practitioners or carriers. The more narrowly a practice is framed and thus the smaller its group of carriers, the easier it becomes to analyse and capture this target practice and to compare it to varieties outside of the selected framing. In the empirical projects for example, the focus has been on the Netherlands (sometimes extended to Europe), but nation states do not have to dictate the framing. Within the broad category of household practices, all kinds of groupings of varieties can be distinguished. Some examples for bathing are: showering and taking a bath, morning and evening baths, private and communal bathing – each implying a different sub-group of carriers.

A third recommendation is to frame the practice as an activity. The staying warm at home projects, for example, started from the observation that in Europe, heating of the home accounts for the bulk of household energy consumption. However, heating of the home is not a practice. In these projects, the practice was reframed several times along the way, resulting in a rather long and complicated framing that was later shortened to practices of staying warm at home. What becomes clear from this example is that framing of the practice can be adjusted during the project. Initial framing of the target practice merely forms the starting point for the first step in the analytic process, being the quantification of consumption indicators.

5.3.1 Quantifying consumption indicators

The first step in the recommended practice analysis process is gaining an overview of the levels of resource consumption involved in the performance of the target practice. Because levels of resource consumption are so central to the approach, consumption metrics are added to the images-skills-stuff model, as shown in Figure 5-6. The white circles in the figure indicate that the practice is at this point not analysed yet in terms of the elements and links involved.

For quantifying direct resource consumption, expanding the unit of analysis from interactions to practices means that resource consumption is described per unit of time per person or household and not per instance of use of a product. For example, in the empirical projects, consumption was described in terms of litres of water used for showering per person per week, or energy consumed for space heating per household per year. Regarding these indicators, three main types of consumption data are collected: current day averages, varieties on this average and historic trends. This data is used to compose an overview of consumption levels and to determine a target level.
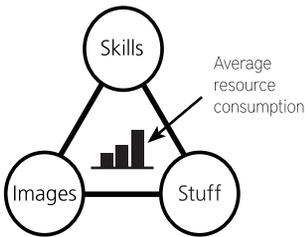
Figure 5-6 The practice as a constellation of images, skills and stuff and a certain average level of resource consumption per performance.

Averages and variety

To be able to talk about reductions in resource consumption, a benchmark consumption level, i.e., a base level to reduce from is required. This base level is represented by a current average. Besides current averages, however, a practice-oriented analysis includes an interest in deviations from this average and in extreme values, both within the target practice and in similar practices outside of it. This position acknowledges the high variety in performances and thus in levels of resources consumed that exists within each practice. Moreover, it highlights, in order of magnitude, examples of manifestations of similar practices with a relatively low level of resource consumption. For example, bathing in India entails strongly lower levels of resource consumption than bathing in The Netherlands, and on average the Japanese manage to stay warm at home using a fraction of the resources Dutch people require in the same practice. This idea of variety in levels of resource consumption between similar practices is visualised in Figure 5-7.
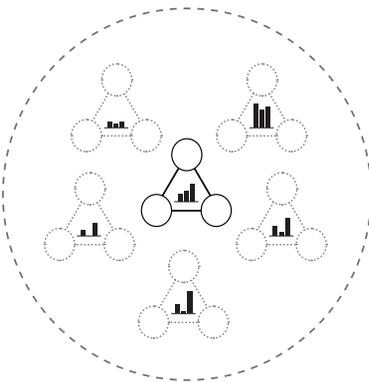
Figure 5-7 Levels of resource consumption of the target practice and several varieties.

Historic trends

Besides current averages and varieties within and outside of the target practice, this first quantitative exploration collects data on the historic developments of resource consumption of the target practice. This data is useful for two main reasons. One, because it gives an idea of long-term trends and expectations for the near future, and two, because it highlights an order of magnitude of less resource intensive varieties that have worked in the past. Figure 5-8 visualises this idea of historic development in levels of resource consumption. How far to go back in time depends on the practice, but the empirical projects showed that going back at least a century is far more insightful than going back just a couple of years. It has to be noted however, that obtaining data may in some cases only be possible on the basis of qualitative descriptions of historic practices, which means that an overview can only be obtained in parallel with the detailed analysis of the practice's historic career and not before it as suggested in the analytic model.
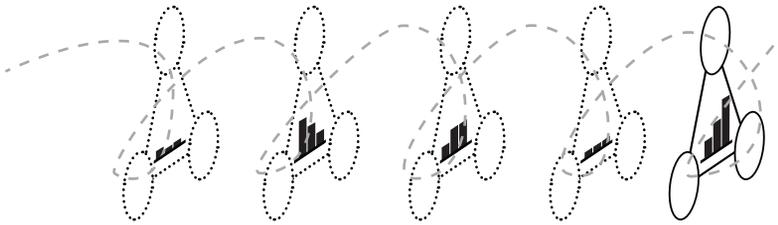
Figure 5-8 Potential trajectory of varying levels of resource consumption of the target practice over time.

Determining a target level

Based on contemporary and historic variety in levels of resource consumption of the target practice, a theoretical target level (Figure 5-9) is selected. The target level is meant as a point of reference to trigger an ambitious search for opportunities and not as a requirement to judge eventual success of an intervention. Based on the idea that varieties of the practice represent configurations that work or have worked in the past, the target level is based on varieties at the lower end of the scale. Besides the idea that levels of resource consumption of the target practice are currently too high, determining a desirable level to change towards is a crucial and sensitive normative characteristic of the proposed approach. Crucial, because as observed in existing sustainable design approaches, when the target level is taken too close to contemporary averages, or not defined at all, there is a risk of achieving incremental reductions at most, and sensitive because the choice is always to some level arbitrary. When taking no resource consumption at all as the ultimate limit, no life would be possible. Reasoning back from this limit brings to the fore ideas of basic human needs for subsistence. Although it can be argued that barely surviving is not an acceptable way of living, a practice-orientation takes the stance that what is

Figure 5-9 The target level of resource consumption.

acceptable is something that is eventually formed in performance. In other words, needs are made, they are part of practices and thus subject to change. In order to face the challenges of required reductions of 70%, as introduced in Chapter 1, challenging targets should be selected. In the empirical projects, these targets were based on similar varieties with strongly lower levels of resource consumption combined with a notion of basic human needs. In the bathing projects for example, a reduction from 340 litres of warm water consumption per person per week to 105 litres was set as a target. This target is based on current averages and a combination of consumption levels in India, Dutch consumption levels of the 1950s and the UN recommended minimum water availability for bathing. The following section will elaborate on ways of collecting data for the creation of an overview of consumption indicators.

Collecting quantitative consumption data

There is a variety of sources to collect the required data on household resource consumption. However, even when you know what you are looking for and know where to look, it is not easy to compose a comprehensive overview of averages, historical trends and variety. For example, aggregate data on electricity, water or gas consumption per household is not very useful when looking for consumption metrics on a practice level. Some sources show, next to averages, standard deviations or even extreme values, but most do not. In the bathing case, data on variations was obtained through personal communication with the conveners of a detailed water use study. In the staying warm case, a study on a number of specific housing projects provided some insight in the range of variety in levels of resource consumption for space heating. As mentioned, some sources contain a trend over time, but very few go back further than 10 or 20 years. Key sources for consumption indicators used in the empirical projects contained only averages and went back only as far as 1992 and 1990 respectively. Therefore, an overview of historic developments in levels of consumption could only be made after consultation of a variety of sources, including a set of qualitative descriptions from which levels of consumption could be estimated. Finally, systematic data for developing countries is often lacking and data for different countries or sub-groups is not always on the same level (e.g. water use for personal hygiene and water use for showering are not directly comparable). Two other key sources in this phase of analysis that are worth mentioning were the paper 'Basic Water Requirements for Human Activities: Meeting Basic Needs' (Gleick 1996) and a report titled 'Energy Requirements for Satisfying Basic Needs' (Zhu and Pan 2007). These sources have been used, in addition to data on varieties with a low level of resource consumption, to determine target levels.

Overview of quantitative consumption data

Figure 5-10 visualises how the different types of data (current day averages, varieties, historic data) collected in this phase and the selected target level relate to each other, both in terms of consumption levels and in the setting of their related practices. This overview forms and intermediate result in the practice innovation process, and a framework to guide subsequent analysis.
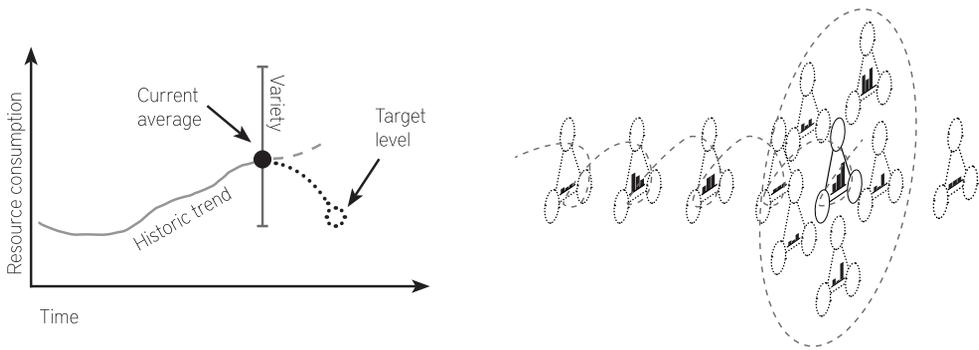
Figure 5-10 Overview of types of data collected for quantifying consumption levels in terms of numerical values (left) and in relation to the practices they are implicated in.

The next step in the practice analysis process is analysing the practices 'behind' these numbers. This step has three focal areas: tracing historic career, exploring desirable varieties and mapping the target practice. Result of this step is the identification of opportunities for desirable change.

5.3.2   Tracing historic career

A review of existing approaches in practice-oriented design has indicated that attention for the historic career of a target practice can greatly contribute to both understanding it and finding opportunities to change it. Along these lines, one of the tenets in the POPD manifesto reads:

> 'POPD understands that history matters! Understanding the dynamics of practice means understanding continuities and patterns of co-evolution over time: look backwards to see forwards.' (Shove and Watson 2006)

Understanding the target practice

What analysing the historic career of the target practice has shown to contribute to in the empirical projects is understanding the target practice and how it is both stable and dynamic. Historic analysis reveals elements that have proven core to the practice, such as for example water in bathing, elements that are more recent but literally fixed like water and gas infrastructures or central heating, developments that are difficult to reverse, like knowledge of bacteria and viruses or expanded expectations of living space, or links that have become deeply engrained, like those between cleanliness and social status. However, it also highlights how the complexes of images, skills and stuff making up the target practice at different moments in history have changed over time, sometimes even diametrically. For example, bathing has shifted from being a social to a private activity, and from a health threat to a cure and public health requirement. It also revealed how some elements are not as fixed as

they may seem from a current day perspective. For example, while showering seems an absolute necessity for Dutch people today, it has only recently become popular.

Because an analysis of changing practices-as-entity implies analysis 'both of the history of the elements involved and of the dynamic and often uncontrollable or emergent relation between them' (Shove and Walker 2010), results of such analysis are best represented in narrative form. In addition, to gain an overview of different configurations of elements over time and ways in which the practice has changed, the empirical projects used additional tables. While bathing is described in terms of different constitutions of elements in different periods of time, the description of staying warm at home zooms in on shifts in the constitution of elements. While the overview of bathing particularly highlights stability and dynamics of the constitution of elements, the overview of practices of staying warm highlights how elements have been recruited into and have disappeared out of configurations over time. For example, with the introduction of liquid fuels, a range of stuff and skills such as mending coal fires and coal scuttles became obsolete.

Inspiration for less resource intensive configurations

A second function of historic analysis is obtaining insight into less resource intensive configurations of a practice. Since overall household resource consumption has in most parts of the world steadily increased over the past centuries, it can for many practices be expected that their levels of resource consumption have increased over time. Historic manifestations of the target practice are therefore likely to represent examples of less resource intensive varieties that have worked in the past. This does not mean that the way things were done in the past can simply be brought back; those practices worked as part of another web of practices and may therefore not work today. They can however form a source of inspiration for the identification of desirable, yet feasible directions for change. For example, the relation between clothing and indoor temperature settings, or the observation that for centuries, and even for living generations, a basin, a jug and just a couple of litres of water have been sufficient means to get rid of 'dirt' and achieve socially acceptable levels of cleanliness.

Although representing a particular interpretation of the historic career of the target practice, what both overviews highlight is the temporality of the current status quo and the possibility of extensive change in the future. These functions of tracing the historic career of the target practice are summarized in Figure 5-11.
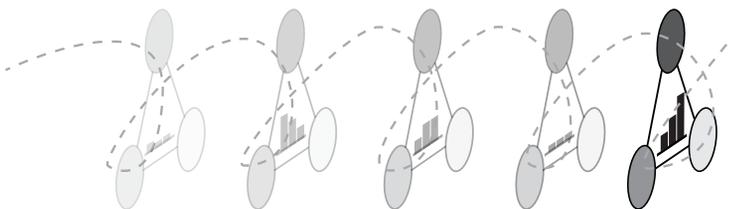

Figure 5-11 Tracing the practice's historic career gives insight into its current configurations, their potential future paths and ways in which less resource intensive variations were constituted

Sources of information

Although somewhat outside of mainstream design literature, the empirical projects described in Chapter 7 and 8 have shown that sources of information for tracing these practices back in time are available. Some even provide ready-made historical overviews. These overviews cover various time spans in various levels of detail. Examples used in this thesis are Overbeeke's (2001) thesis 'Stoves, geysers and cookers; choice processes and energy consumption in Dutch households 1920-1975', which treats a relatively short time span in a highly detailed way and focused on the Netherlands, and the far more general 'At home: a short history of private life' by Bill Bryson (2010), which goes back approximately 150 years. On a different scale, Stuller (1991) covers over 2000 years of bathing practices in just one article. While such overviews can be found on a variety of topics, there are alternative sources for historic analysis that can be consulted. Examples are historic documents (in the bathing projects, Kira's 'The Bathroom' (1976) was partly treated as such), museums of history (useful also for obtaining visual material or the possibility to interact with objects used in the past), experts (for example those connected to museums of history), and people from previous generations in general. Section 5.4 will present some recommendations for interviewing people from previous generations as a specific research method.

5.3.3   Exploring similar practices

In addition to tracing the target practice's historic career, the analytic model recommends exploring desirable, similar practices. In the proposed approach, the selected target practice forms a starting point to change from, while different but similar practices, in space and time, form both points of reference to position the target practice against, and examples to identify opportunities for change.

Positioning the target practice

It was found in the analysis of existing practice-oriented design approaches, and confirmed in the empirical studies that by studying varieties of the target practice, the designer obtains a certain distance from it and creates points of reference that can highlight aspects of the practice that may have otherwise remained unnoticed. For example, the standing posture in showering that was highlighted in reference to forms of bathing performed in a sitting posture, or the idea of space heating versus person heating that emerged after studying practices of staying warm in Japan.

Desirable practices

A second goal of studying varieties is to flesh out the less resource intensive practices identified in the overview of levels of resource consumption (Figure 5-12). Again, it is important to note that these desirable practices cannot simply be transferred into the target practice because they work in a different setting, but they can form a source of inspiration for how the practice can be configured differently. For example, the Indian bucket bath is far less resource intensive than the Dutch shower. This insight contributed to the selection of bathing with contained water as an opportunity for change. Whether
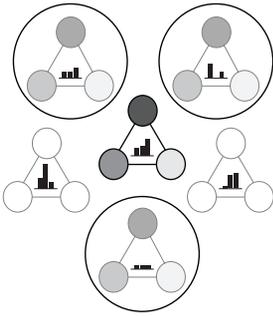
Figure 5-12 Select and analyse similar practices with resource intensities lower than the target practice.

a lower resource intensive configuration is considered a variety of the target practice, or a similar, but separate practice can be a point of debate, but in the end it doesn't matter for the type of analysis conducted. In the two empirical projects, the varieties studied were examples in other countries, but studying similar practices does not necessarily mean crossing borders. A study affiliated with this thesis work, for example, studied plant-based eating as a desirable form of eating practices in the Netherlands (Putman-Cramer 2011).

Sources of information

Again, literature is the first source of information to turn to when investigating practices in foreign or sub-cultures. Describing such practices is the field of expertise of (social/cultural) anthropologists. Works used in the empirical projects were for example Clark's 'Japan: a view from the bath' (1994), which was highly focused on the topic of interest, and the more general 'The Japanese House' (Daniels 2010). For India, however, it turned out to be difficult to find anthropological descriptions of bathing practices. Another problem with these accounts is that, other than historic accounts, they form a snapshot and thus easily become outdated. For example, bathing in Japan has presumably changed quite a bit in the almost 20 years since Clark published his book. Another, more popular and up-to-date source of information about practices in other cultures are writings directed at international travellers. Tourist guides and blogs, although variously reliable, provide hands on information initiating the novice into the practices of the country they are visiting. These sources thus tend to present practices on a silver platter. Still, information on required levels of detail is not always available. Therefore, a particular approach for collecting data on practices in other cultures was developed within a master graduation project related to this research. The approach was applied in an empirical study on bathing practices in India and Japan (Matsuhashi et al. 2009) and will be explained in Section 5.4.

5.3.4   Mapping the target practice

When the designed is a carrier of the target practice, as was the case in both empirical projects, studying it is especially challenging. As Hockey concludes in his paper on researching peers and familiar settings, '[t]hat which is closest may well be that which is most difficult to see…' (1993: 221). Tracing a practice back in time and exploring similar practices among different cultural groups provides some distance from which to see familiar practices more clearly (Figure 5-13). It is therefore advised in this approach to study the details of the target practice after performing these other two analytic activities. Nonetheless, choices have to be made about the angle to take when presenting an
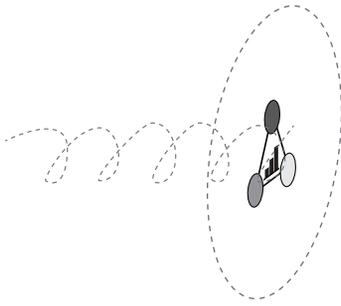
Figure 5-13 By analysing historic career and alternative configurations, the target practice is highlighted and fleshed out.

overview of the target practice. In making these choices, the objective of the overview should be leading. In the empirical studies, analysis of the target practice led to two main results. The first is an overview of relations between resource consumption and the constitution of the practice, and the second, following from this overview is a list of core characteristics regarding opportunities for change in less resource intensive directions.

Connecting consumption levels and configurations of elements

In the context of sustainable design, analysis of the target practice pays special attention to how its current constitution is related to its resource requirements. Questions of why the practice has the level of resource consumption it has, and how this is related to the way it is constituted, form an important first step in identifying opportunities for change. In the empirical projects, a dissection into relations between images-skills-stuff elements and a set of practice specific consumption indicators turned out to make most sense. In showering, these indicators were flow, duration, frequency and temperature of showering, and in the staying warm projects, indoor temperature settings became central in making sense of the relation between practices of staying warm and their levels of resource consumption.

Inertia, priorities and tensions

The overview of relations between consumption indicators and the constitution of the practice forms the basis for the identification of three main sets of conclusions about the target practice. These include a list of strong links and core elements that give an idea of the inertia of the practice, threats and trends regarding resource consumption, which highlight points of priority for intervention, and finally a set of tensions, indicating potential opportunities for intervention in the practice and possible ways of disrupting its current configuration. Besides studying the target practice, another way to highlight tensions that came to the fore in the empirical projects is to take a close look at the moments when the currently dominant practice became successful. In such transformational moments, advantages and disadvantages of the practice that later disappear into the background are discussed widely. For example, in marketing campaigns for products associated with the practice or in responses to new products by novice users. With the introduction of central heating, for instance, producers of stoves started to position their products as the more cosy alternative. And in bathing, Kira explains that novice users of the shower experienced it as 'uncontrollable, destructive and rough', difficult to get clean by and uncomfortable because it required a standing position (1976). This knowledge could be used to problematize central heating and showering in the light of a more desirable alternative.

As observed in Chapter 4, tensions in the practice have to be approached with care. Clearly, the practice works in its current configuration for those carrying and performing it. When identifying tensions, the designer has to be aware whether the tension exists in the practice, or whether this is a tension merely identified from the normative point of view of the designer. For example, in the bathing studies, a tension was identified between common understandings of proper shower frequencies (i.e., daily) and actual shower frequencies. This tension became clear through remarks of practitioners and can thus be viewed as internal to the practice. Another tension identified was between the paradigm of flowing water and getting clean. This tension was identified by investigating the chemistry between water, soaps and skin and from remarks of experts, but it is not something that is present among carriers as a tension; generally, people feel they get properly clean in the shower.

Sources of information

Mapping of the target practices was done using a wide variety of sources, including the authors own experiences and informal conversations. These sources of knowledge about the target practice will be discussed in detail in Section 5.4.

Identifying opportunities and directions for change

Keeping in mind the selected target levels for resource consumption, opportunities for change identified in the projects combined tensions in the constitution of the target practice with opportunities found in more desirable variants (contemporary or historic) of the target practice. In the bathing studies, for example, a strong connection was found between the paradigm of flowing water that is inherent in showering, and high and raising levels of resource consumption, while at the same time several (implicit) tensions were found related to this paradigm. Examples from other cultures and bathing practices in the past highlighted washing with water from a reservoir as a strongly less resource intensive alternative. Thus, making a shift from washing with flowing water to washing with water from a reservoir was identified as a plausible and desirable direction for further exploration. In the staying warm projects, a practice-oriented view on comfort as a negotiable construct opened up opportunities for strongly reducing indoor base temperatures, which were identified as main indicators for levels of resource consumption. Prerequisite for making this work is to offer people an expanded set of ways to make themselves comfortable. Based on the identification of Dutch heating practices becoming increasingly space oriented, the direction for design became to explore supplementing these with more person oriented ways of staying warm. Although context dependent, both lines of reasoning follow a similar pattern that is supported by the data gathered in the different parts of the practice analysis model.

In conclusion, like any design model, the approach recommended here is not a recipe for success. It is argued however, based on experiences in a series of empirical projects, to be able to structure a practice-oriented analysis process for the identification of plausible, yet desirable opportunities for design intervention. These opportunities form the starting point for the next, generative phase. Before going to this generative phase, this chapter closes with a set of more detailed considerations and recommendations to gather empirical data on practices for designers.

5.4 Challenges of and recommendations for analysing household practices

The previous section proposes a general model for taking practices as a unit of analysis in sustainable design. Because sustainable design is in this thesis framed as design directed at reducing levels of resource consumption in households, such analysis inherently deals with household practices. This section first outlines a number of specific challenges of analysing contemporary and historic household practices, and subsequently offers a number of recommendations for gathering empirical data on them in the context of sustainable design projects.

5.4.1 Challenges of studying household practices

As explained in Section 5.2, the practices(-as-entity) can only be studied indirectly and designers therefore have to rely on various sources of inherently partial knowledge. These sources can be summarized as the bodily performances in which the practice manifests, and practitioner's rationales and material artefacts that carry the practice. The sections below discuss these sources and the challenges entailed in accessing them.

Bodily performances
As explained in Section 5.2, it is in performances that subsets of elements comprising the practice-as-entity are actively integrated. However, directly observing single performances, in the case of household practices, is often practically impossible. Household practices can be highly private, such as bathing and hair care (Hielscher 2011), or strongly dispersed in time, such as staying warm. Moreover, the domestic setting, as opposed to for example public settings, makes observing participants, without influencing the performance very difficult (a nice illustration of this point is worked out in the movie Kitchen Stories). Additionally, regardless of these difficulties observation (alone) is not the most effective way of gathering information about the practice-as-entity, because each single performance represents just a tiny part of this entity. Discursive accounts can give a more complete overview of the multitude of elements and links in the practice-as-entity, because through them the designer can get access to the variety of performances familiar to the participant. Moreover, discursive accounts can provide access to aspects of practical knowledge that will, in normal performance, be left unexpressed. It is for example not possible to observe what someone is feeling, smelling or thinking.

Giving accounts of mundane, routine performances, however, is not easy for people. One, because this is not something they are used to doing. Two, because in some cases it can be embarrassing and private. And three, because performances are routine and therefore executed without much deliberate attention. Hielscher, when reflecting on her study into hair care practices relates for example:

> 'Numerous times during the interviews women asked if they were 'boring me to death', as they were talking about mundane activities in great depth.' (2011: 71)

Additionally, as in bathing for example, cleaning genitals or details of smells and dirt are sensitive topics for most people that are difficult to address in an interview.

Practitioners' rationales

Besides detailed accounts of (a variety of) routine performances and bodily knowledge, discursive accounts can also give insight into what Shove describes as 'the range of rationales that justify and at the same time provide a guide for practice' (Shove 2003). This range of socially shared rationales, however, is not easy to access, especially not in the case of domestic practices. What makes this particularly difficult is the fact that in many of the mundane, everyday practices that are relevant to resource consumption in the home, the designer is an expert practitioner too. While it can be an advantage to be an 'insider' to the topic under investigation, because people are more likely to reveal private information when similar experience is more likely (Platt 1981), the presence of shared knowledge between interviewer and interviewee can inhibit the collection of clear and explicit data. Shared knowledge is an important element of the practice, but it is exactly there in what is not said or mentioned in everyday conversation between practitioners.

In interviewing, there are several strategies to reveal these common understandings. For example, something Kvale refers to as 'deliberate naïveté' (Kvale 1996), in which the interviewer takes the role of a novice, asking the interviewee clarifying questions about things the interviewer 'actually' knows. However, the role of someone not knowing anything about showering or thermostats is rather impossible to keep up for a Western European. Moreover, taking this role can be risky; there is a thin line between being an interested interviewer and being regarded irritating or even crazy. Famous in this regard is the work of Garfinkel.

Besides recognizing that common understandings remain implicit in everyday interaction, Garfinkel (1964) also observed that people are generally not able to verbalize them even when asked. Therefore, he designed a set of experiments to reveal what he refers to as 'the common sense world of everyday life'. Students were instructed to, in everyday conversations, without warning ask their conversation partner to 'clarify the sense of their commonplace remarks'. They did this by repeatedly asking 'what do you mean by …' to common questions like 'how are you' or remarks like 'I'm feeling tired'. Such experiments, Garfinkel argues, have the capacity to produce reflections through which the 'strangeness of an obstinately familiar world can be detected' (Garfinkel 1964: 227). However, when challenging everyday understandings by frequently asking for clarification during a normal conversation, Garfinkel's experiments also show that one easily gets categorized as unreliable or even mentally ill. After just a few sentences, conversation partners would call the students 'sick' or get seriously annoyed. It has to be noted that an interview is a particular form of conversation in which an interviewee will be more open to answer clarifying questions than in the type of conversations described by Garfinkel. Nonetheless, asking clarifying questions to participants, and having them explain common understandings and well understood rationales in detail can be a great challenge, and can put pressure on the relationship between the designer and the participant.

Material artefacts

Besides being carried by practitioners, practices reside in the material artefacts that form part of the practice. Things cannot be interviewed, but they can convey information about the practice. In the words of Reckwitz, things 'enable and constrain the specificity of the practice' (2002b: 212). What was found in the empirical studies, however, is that these allowances and constraints are necessarily relative and the way they are uncovered strongly dependent on the implicit or explicit reference points taken when approaching the practice. For example, the obvious point that showers (in their design common in the Netherlands) allow for use primarily in a standing position, was highlighted when a Japanese student compared ways of bathing in India, Japan and the Netherlands. Because being so obvious, this point may have been overseen without the identification of other common bathing postures. Conversely, the fact that Dutch shower design makes it quite impossible to wash your car in the shower for example, is not highlighted until this way of use surfaces as common elsewhere, which it so far did not. Revealing the allowances and constraints of the artefacts implicated in the practice is therefore dependent on the reference points taken when approaching them.

In summary, it can be concluded that obtaining an overview of a practice-as-entity is challenging, and always incomplete and temporal because:

- The practice-as-entity can only be accessed indirectly through performances, people and artefacts.
- The entire range of varieties of manifestations (performances) that make up the practice-as-entity can never all be taken into account.
- The range of rationales, or mundane, common understandings between practitioners are difficult to access, especially for an insider.
- The affordances and constraints of artefacts depend on the angle from which they are viewed, i.e., the point of reference taken
- and finally, the practice continuously changes, so any overview is necessarily a snapshot.

5.4.2 Recommendations for empirical data collection

Recognizing the challenges and limitations set out above, the following sections contain a number of recommendations on obtaining empirical information about contemporary and historic practices. These recommendations are based on experiences from the empirical projects. The section deals with how interviews can be used to access bodily performances and practitioner's rationales, how workbooks can support and supplement gathering this type of data. Thirdly, it deals with the topic of studying material artefacts.

Interviews

In the empirical studies, interviews were conducted for gathering data about bodily performances and underlying rationales. Relevant for all types of interviews is that in the context of sustainable design, a particular goal of obtaining empirical data about practices is making a link between levels of resource consumption and the constitution

of the practice. This particular goal should be reflected in the topic list the designer takes to interviews. In the bathing projects for example, such topics were: bathing frequencies, times of day and durations, the use of soaps and/or shampoo and frequencies.

To get an idea of bodily performances without directly observing them, the interviewer aims to get insight into all actions taken and their sequence. Such interviews can start with a general question to the participant to explain what type of practitioner they are. For example, 'can you explain what type of bather you are' or 'how do you go about staying warm at home in winter?'. However, interviewees tend not provide a great level of detail in their explanations. To obtain more detail, it is helpful to assure anonymous treatment of data and to emphasise the interviewers interest in seemingly boring details. Additionally, several interview techniques can help people to recollect details of performances. Besides repeatedly asking for detail, examples are conducting the interview in the place or places where the practice is performed, using props (artefacts related to the practice), asking people to re-enact their routine, or evocative interviewing (Hielscher 2011). Beyond the interview itself, interviewees can be prepared for the interview through workbooks. The use of workbooks has a number of other advantages that will be discussed in more detail below.

Challenges and strategies for accessing underlying rationales differ depending on the type of practice studied, being historic practices, similar practices in other cultural settings or the target practice. Each will be briefly discussed.

To supplement accounts from literature on historic practices of staying warm with empirical data, interviews were conducted with two couples from previous generations. Because these interviews concern practices that are no longer performed, interviewees have obtained a certain distance from them, which makes accessing the practice-as-entity relatively easy. Keeping this distance can be enhanced by phrasing questions in a general instead of a personal way. For example, asking 'what was it like in winter during your childhood', instead of 'how did you go about staying warm in winter when you are a child'. In the empirical projects, this question, with the occasional question for more detail, was sufficient to obtain an account that greatly enriched the data available from literature. Especially helpful in this regard was conducting the interviews with couples. They would complement or contradict each other, thus providing a rich narrative.

Regarding practices in other cultural settings, a comparison was made between Dutch, Indian and Japanese ways of bathing, and ways of staying warm in Japan were studied. In this case, it is the designer that has a useful distance from the practice, and is thus in a position to ask explanatory questions more freely. This distance comes with its own challenges, but other than referring to the extensive body of literature in anthropology on this topic, they will not be further discussed here.

In case of interviewing people about the target practice, both interviewee and designer will generally be carriers of the practice. As explained earlier, this poses great challenges. Therefore, it is recommendable that the designer collects information about its historic career and examples in other cultural settings before conducting these interviews. This way, a certain distance can be created. Still, it remains challenging to uncover underlying rationales and common understandings. A couple of recommendations can be made regarding types of questions to ask. Since these rationales include skills of judging whether something is good, clean or proper.

A particular type of questions can uncover these skills, for example 'how do you know whether your hair is dirty' or 'how do you know when to ventilate' and to aim for concrete answers like 'when my fingers become sticky when I go through it' or 'when the windows fog'. Moreover, for uncovering common understandings, the interviewer should be particularly attentive to terms like 'long', 'far', 'a lot' or 'low' and ask for clarifications. In the bathing study for example, if participants would typify themselves as taking 'long showers', the interviewer would ask to specify what is long, aiming for a number of minutes. What such adjectives imply is a norm, as perceived by the interviewee, from which he or she feels to deviate to some extent. An additional question could therefore be, if they for example feel 20 minutes is a long shower, what they then consider to be a normal shower duration. However, as mentioned, there is a risk of disturbing the relation with the interviewee by asking such 'stupid' questions. Another strategy for revealing common understandings is raising the topic of alternatives. Asking interviewees to compare the target practice to other, similar practices or to ask about exceptional situations (for example when on holiday), turned out to reveal underlying rationales that otherwise remain implicit. For example, when Daniel remarks that when on holiday he really likes to take a shower, but at home he clearly prefers the bath, because his bath is important to wash away fatigue of work, rationales for taking a bath are highlighted in reference to taking a shower (on holiday) (field study interview FamD). On the blog of the experiments in practice study, a participant relates that because her heater was broken, she took cold showers for two days, and another participant describes a camping holiday where one night she used a cold, dark, public bathroom to take a shower, because it was 'the ONLY option'. For both these participants, not taking a shower at all was, even in these circumstances apparently not considered an option at all, which highlights daily showering as the norm for them.

Workbooks

In the empirical studies underlying this research, workbooks were used both to support and to supplement the interviews. Workbooks can support interviews because they enable participants to make notes on their performances and experiences close to the situation of performance. Moreover, a workbook can be in the field for an extended period of time, over the course of several performances, so participants can go through it at their own pace and questions can linger on during performances and thus stimulate reflection. To further support documentation of performances, workbooks can contain particular documentation formats, such as the action card format developed by Matsuhashi et al. (2009) in the bathing studies (Figure 5-14) and additional tasks, such as recording durations of actions or taking photographs of settings.

Figure 5-14 Workbook and action cards that were used in one of the bathing related projects (Matsuhashi et al. 2009).

Additionally, workbooks have a number of particular functions and advantages by which they do not only support interviews, but supplement them. These advantages are listed below and illustrated in the following figures with examples from the empirical studies:

- Workbooks can be used as survey forms (Figure 5-15).
- A workbook can contain explanations and explanatory figures (Figure 5-16).
- A workbook can ask participants to draw (Figure 5-17).

Fri 14 **Sat 15 Sun 16** Mon 17 Tue 18 Wed 19 Thu 20

mapping your bathing routine iii
Since this study is about making bathing more sustainable we would like you to estimate your current resource consumption in bathing at home. Again we want to point out that this is in no way a judgment of your environmental consciousness; we are simply curious about how things work for you.

average number of showers per week and average duration:	_____ per week _____ minutes remarks:
average number of baths per week/month:	_____ per week/month (underline appropriate option) remarks:
kind (bar, liquid, other) and frequency of soap:	Kind _____ Frequency _____ remarks:
kind (bar, liquid, other) and frequency of shampoo:	Kind _____ Frequency _____ remarks:
other products you use:	
Other sustainability issues in	

Figure 5-15 A survey form in the experiments in practice workbook.

Studying material artefacts

Although things clearly play an important role in constituting practices, how to approach them in the context of practice-oriented design is a topic that writings so far offer little guidance on. This section therefore draws on the small pool of existing literature, and experience gained in the empirical projects conducted for this thesis. Two points of attention for studying artefacts for practice-oriented design are listed here: artefacts as part of a network of stuff and 'future' things.

In practice-oriented design, things are approached as part of a composition. The POPD manifesto states that

> 'POPD recognizes that no object is an island, so it attends to the relations between products, not to objects in isolation.' (Shove and Watson 2006)

To specify this, analysis of the material aspects of a practice includes simply all artefacts visibly deployed in the performance. In bathing and staying warm, these are for example taps, showerheads, thermostats and sweaters. The network includes the spaces in which performances take place, the human body, but also things not directly visible, such as

practice theory and co-design

The underlying framework of this study stems from the merge of two principles: co-design and social practices theory. In co-design, users are actively engaged in the product design process with guidance from a professional designer. In this method products are the main focus in the use context.

Social practice theory looks at consumption in a much broader sense; taking into account the interconnected elements of skills, images and stuff. This is explained below, using the practice of cooking as an example.

Understanding, knowledge, ability
Family recipe, how to do dishes, bake an egg

SKILL

IMAGE

Emotions, meaning, identity
Look forward to good meal, like cooking for family, food needs to be healthy

STUFF

Materials, technologies, artifacts
Pots, pans, fridge, stove, sink, etc.

Practice theory: *the cooking example*
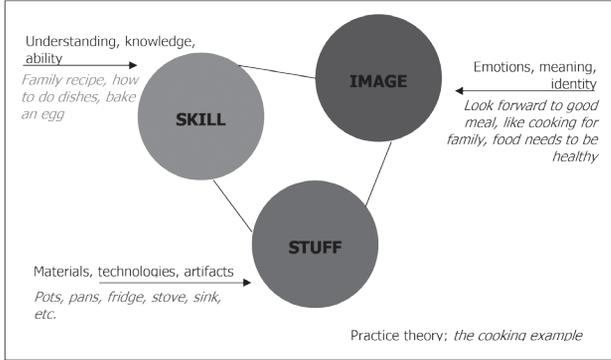
A limitation of social practice theory is that it does not lead to product ideas in itself. Therefore the idea arose to combine this theory with co-design techniques creating a method of experiments in practice.

Figure 5-16 An explanation of concepts from practice theory to support a particular form of documentation and reflection.
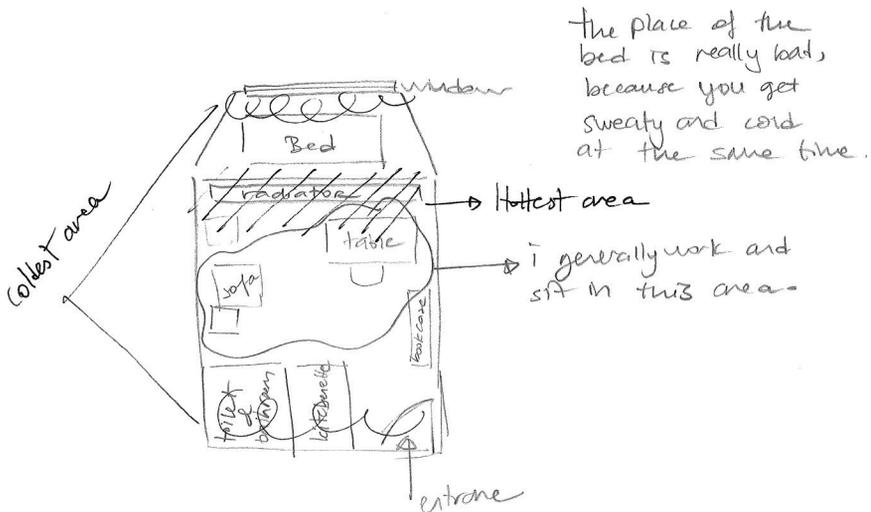

Figure 5-17 A drawing from a workbook in the trigger-product study.

water pipes, boilers, sewers, gas infrastructures, up to oil platforms and wastewater treatment, or the sun and clouds. Other than things obscured from direct view, the practice-oriented designer is also interested in things that are too little to see. The importance of things like sebum, grease and follicles already became apparent in Chapter 4, where they were brought to surface by Hielscher and Scott. Their relevance was confirmed in the empirical projects, where for example the importance of air and things like draught and ventilation came to the fore in the studies on staying warm. Products also easily overseen, but yet found important by Hielscher are things that are no longer used. Finally, besides listing all things, visibly and invisibly implicated in a practice, it is also important to look at their relations with each other. For example, Hielscher (2011) emphasises her observations of the ways in which things were organized spatially in her participants' homes.

While future performances or future people are not available for analysis, 'future things', or at least potential future things, in varying stages of development are widely available for study. New product proposals are widely available through websites, commercials, trade fairs, magazines, showrooms, blogs and so on. To analyse developments in the bathroom market, for example, the ISH fair (International trade fair for the Bathroom, Building Services, Energy, Air Conditioning Technology and Renewable Energies) was visited twice. Studying such technological developments is a routine activity for industrial designers. The recursive relation between objects and practices, between design and use, as visualised by Ingram et al. (2007) in Figure 5-18, implies that new products both incorporate industry's ideas about current practices, and potential for future practices. Analysing new product proposals therefore reveals something about current practices, and about directions in which they may head.
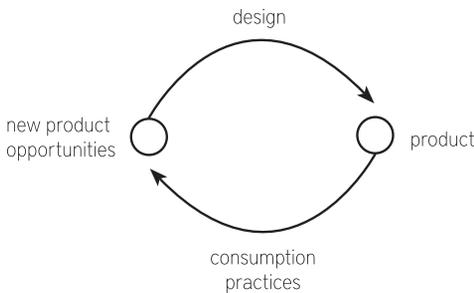
Figure 5-18 Cyclical model of designing and consuming (adjusted from Ingram et al. 2007: 3).

5.5   Conclusions

This chapter set out to provide an answer to the question 'What does it mean to take practices, instead of interactions as a unit of analysis in sustainable design?'. The recommendations presented above form a (possible) methodological answer to this question. From these recommendations, it becomes clear that the analytic activities in a practice-oriented approach differ from those in an interaction-oriented approach in a number of respects.

When looking at interaction-oriented approaches in sustainable design, analysis of the current situation focuses on a particular appliance and the way in which it is used. Consumption metrics, if quantified, entail average values of a single indicator, for example

average yearly electricity use of a fridge, or average water consumption per person per shower. The target level of resource consumption, again if specified, already contains the assumption of a particular type of change in the use of the product. For example, a certain frequency and duration of opening the fridge door, or a certain shower duration. In fact, the focus in this body of literature on selecting the right design strategy to achieve this 'sustainable behaviour' seems to assume that the 'good' or 'sustainable' behaviour related to the selected product is already known; it only needs to be made easier, clear or unavoidable for the users of the product.

A shift from interactions to practices as the unit of analysis in sustainable design entails more than broadening the focus from taking a shower to bathing, or from setting the thermostat to ways of staying warm at home. By including both history and contemporary diversity in the analysis, the target practice is positioned in its broader spatio-temporal setting. This positioning reveals larger changes and ranges of diversity in levels of resource consumption. This overview, in combination with the notion that needs, standards and norms are formed in practices and subject to change, justifies and stimulates the setting of challenging targets for reduction that look beyond the status-quo. Considering ideas of what is normal and thus acceptable as part of the practice, significantly broadens the scope for change that is considered in the project. However, these targets are not formulated in the form of particular behaviours or reconfigurations. Although inherently normative through its environmental orientation, the method acknowledges practices as having their own internal logic that works and makes sense for the people carrying and performing it. Consequently, configurations with lower resource intensity are viewed as emerging from, instead of the starting point of the generative phases of a practice-oriented design process. How these configurations emerge and what the role of the designer can be in this process will be discussed in Chapter 6.

6 Practices as a unit of design

6.1   Introduction

While Chapter 5 discussed what it means for sustainable design to shift the unit of *analysis* from interactions to practices, this chapter investigates what it means to shift the unit of *design* from interactions to practices in a sustainable design context. Once opportunities for designed interventions and promising, desirable directions for change have been identified through analysis, the focus shifts from understanding and gaining inspiration from what currently is, to generating increasingly concrete ideas about what could be in the future. The aim of this chapter is to provide an answer to the question: 'What does it mean to take practices, instead of interactions as a unit of design in sustainable design?'

The chapter starts with a theoretical account on how design, as a particular form of change, can be conceptualised in practice terms. Central to this account is the concept of reconfiguration. To translate this theoretical view into a workable design approach, a link is made between prescriptive design theory and the implications of a practice-orientation. In particular, participatory design, prototyping and iteration are discussed. Based on five generative studies conducted in the context of this PhD research that combined the idea of reconfiguration with these concepts from design theory, a general practice-oriented design cycle is presented and elaborated on in Section 6.4.

Again, the recommendations made in this chapter are based on insights obtained from the empirical projects described in Chapters 7 and 8, and are grounded both in design theory and in social theory. They do not form a rigid approach, although the method outlined can be applied in practical projects as it is, but rather the aim is to set out a framework that is open for further development and criticism.

6.2   Design in terms of practice theory

When positioning design in relation to practice theory, first it is important to make a clear distinction between change and design. Practices(-as-entity) change because of the sum of changes that happen in everyday performance. Change is omnipresent and continuous in practices but not initiated by anyone in particular or directed in any particular direction, while design is about initiating and facilitating change in preferred directions. Moreover, inherent in the idea of preferred directions are judgments of right and wrong, better or worse. In other words, these directions are preferred from a certain point of view, but could be non-desirable from another. Therefore, design is inherently normative.

The type of enduring, large-scale change aimed for in sustainable design implies change in the practice-as-entity; the overarching organizing structure of the practice. However, since entity and performance are so closely intertwined, they cannot be seen as separate from each other. As set out in Chapter 3, change in the practice-as-entity is both a consequence of and a catalyser for changes in performance. In order to form an understanding of how practices change, and eventually, what the role of design can be in this process, this section will first go deeper into the recursive relation between entity and performance by discussing two mechanisms of change: reconfiguration and repetition.

6.2.1   Reconfiguration

Shove et al. write that 'practices change when new elements are introduced or when existing elements are combined in new ways' (2012: 120). New here does not necessarily mean new to the world, but new to the particular practice-as-entity. Therefore, these 'new' elements and combinations (links) will here be referred to as *unfamiliar* elements and links. Notably, unfamiliar elements are not necessarily (only) things; they can also be unfamiliar skills and/or images. Situations in which a performance integrates unfamiliar elements or links, are by Reckwitz referred to as 'crises of routine' – Schatzki calls them

☐ familiar element

▨ unfamiliar element
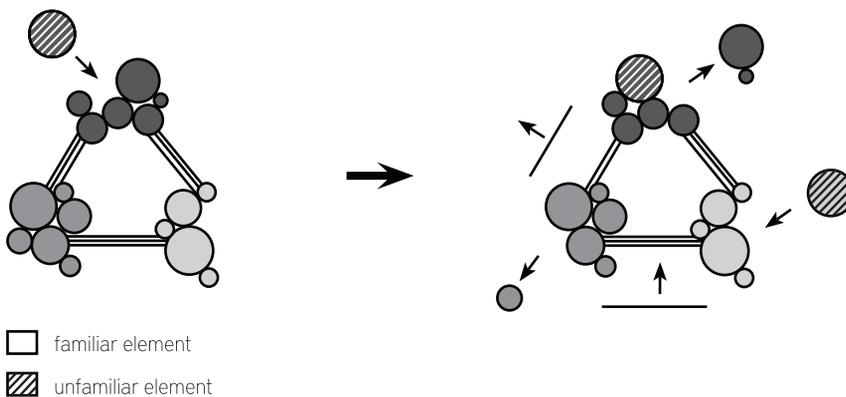
Figure 6-1   An unfamiliar element is integrated in a performance and the practice is reconfigured.

'contingent events' (2001: 53) and Shove et al. 'disruptive moments' (2007: 31) – in which the 'breaking' and 'shifting' of structures takes place (Reckwitz 2002a: 255). This breaking and shifting of structures is here referred to as reconfiguration.

Recruiting unfamiliar elements or links into a performance requires (more or less extensive) reconfiguration of elements and links into a new configuration that works and makes sense. In addition to the breaking and shifting of links described by Reckwitz, this process can also involve recruitment of unfamiliar elements, and rejection of existing ones. In practices of staying warm at home for example, the introduction of liquid fuel has rendered elements like coal sheds, coal scuttles, coal dust and skills of making and maintaining a coal fire obsolete, while piping, oil stoves and skills in preventing fires became required to make the practice work. This process of reconfiguration is depicted graphically in Figure 6-1.

As Shove and Pantzar point out, reconfiguration always happens through bodily performance:

> 'innovations in practice depend upon the *active integration* of elements, some new, some already well established, that together constitute what we might think of as innovations-in-waiting or proto-practices.' (Shove and Pantzar 2005: 48) (emphasis added)

The suggestion to visualise practices as groupings of elements and multitudes of links made in Chapter 5 is helpful in further explaining this idea of reconfiguration. For one, because reconfiguration happens in performance, it only integrates part of the elements and links contained in the practice-as-entity. Secondly, it shows that a reconfiguration is not a completely new configuration, but rather a mix of familiar and unfamiliar elements and links.

Important to note is that Shove and Pantzar refer to these reconfigurations as 'proto-practices' or 'innovations in waiting', and not as 'new practices'. One reason is that such performances in itself do not change the practice-as-entity. Only if the reconfiguration is repeatedly performed by several practitioners, can it become collectively recognized as normal performance and thus as part of the practice-as-entity. This point will be further explained below.

6.2.2 Repetition and recruitment

Before going into the relation between reconfiguration and repetition, it is important to explain something about the role of repetition in the relation between practice-as-entity and practice-as-performance. Schatzki explains that the practice-as-entity forms a structure that establishes certain forms of performance to be correct (in certain situations), and other forms of performance as acceptable (1996: 101). What Schatzki refers to as 'correct' can also be called mainstream. Mainstream is the type of performance most practitioners perform most of the time. For example, in the Netherlands showering is the mainstream form of bathing. Taking a bath is a less common form of bathing, but it is also acceptable.

Along the same lines, Warde explains that 'the patterning of social life is a consequence of the established understanding of what courses of action are not inappropriate' (2005: 140). Consequently, besides establishing whether a performance is correct or acceptable, the practice-as-entity also establishes what types of performance are inappropriate or unacceptable. For example, bathing in a canal is generally not considered an acceptable way of washing the body, and wearing coats indoors not an acceptable way of staying warm at home. Knowing about these categories is part of being a competent practitioner. Notably, these categories of correct, acceptable and unacceptable exist across many different dimensions and vary across sub-groups of carriers. For example, there are correct, acceptable and unacceptable frequencies of washing the body, correct, acceptable and unacceptable indoor temperatures, and so on.

As mentioned, there is a relation between the number of performances of a certain type and the categorization of this type of performance as correct, acceptable or unacceptable. This relation represents a relation between the practice-as-entity and the practice-as-performance. Figure 6-2 illustrates how the practice-as-entity is made up of a variety of situated performances.

What the figure also indicates is that there is no clear line between the categories; e.g., in some situations, for some people wearing coats indoors can be acceptable, while in others it is not. This does not mean, however that a type of performance only rarely performed is unacceptable per see. As Schatzki explains, there are 'ranges of acceptable doings and sayings broader than the behaviours already performed in the practice' (1996: 102). Therefore, it is possible that people happen upon new ways of proceeding that are found acceptable by other carriers of the practice.

Returning to change in practices, what is important to realise is that these categories of correct, acceptable and unacceptable are not fixed. What mainstream forms of bathing are, or acceptable indoor temperatures is something that changes over time. In bathing for example, mainstream practice has over the past century shifted from a weekly bath to (close to) daily showering (Hand et al. 2005). The relation between the practice-as-entity and the practice-as-performance thus conceptualised, highlights that the more a certain form of performance occurs, the more acceptable or mainstream it becomes. This also implies that the effects of any one performance fade over time and thus that a form of performance that is not practiced moves to the periphery of the structure (i.e., becomes a fossil (Shove and Pantzar 2005)).

Summing up, an unfamiliar element or link can change the practice-as-entity by becoming part of a reconfiguration that works, which subsequently recruits more, and more faithful practitioners. More precisely, it is not a particular reconfiguration that can spread, because by recruiting more carriers and through being performed repeatedly, the reconfiguration keeps on changing. Conversely, even if a performance itself, in a particular situation works for the performer, it may not be suitable for repeated performance beyond that situation, by the performer or by others. Links can be made that make no sense (beyond the particular situation) or elements can be integrated that are not available elsewhere. Having said this, the next section will return to the process of reconfiguration, explaining how it is not as straightforward as it may have been presented above.
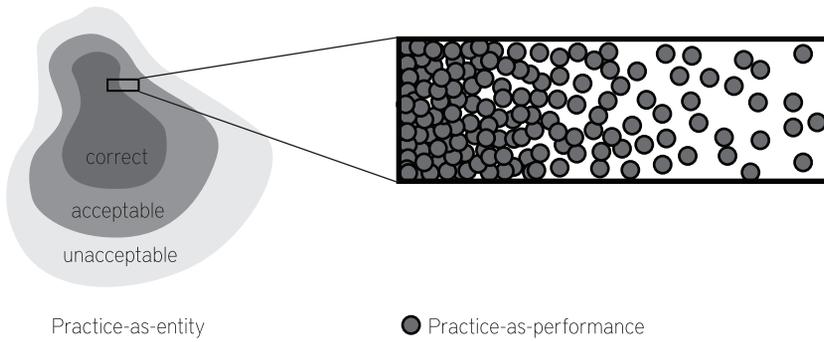
Figure 6-2 A reciprocal relationship between the practice-as-entity and
the practice-as-performance [make 'unacceptable' lighter].

6.2.3   Adaptation, improvisation and experimentation

Following the terminology of Warde (2005), the process of (per)forming a reconfiguration
(i.e. a 'beside normal' performance) is referred to as 'adaptation, improvisation or
experimentation'. It has to be noted that since all practices change over time, change
is part of normal practice. In fact, Reckwitz, connotes 'crises of routine' as *everyday*
crises of routine'. Such situations happen so often that adaptation, improvisation and
experimentation can be seen as routine parts of daily life, or what Schatzki refers to as
dispersed practices (1996: 91) (see 3.7.2). For example, when camping in the wild people
improvise a bath, or when the central heating fails, they adapt for example by wearing
coats indoors. However, because this is where change happens, these practices are of core
interest for sustainable design and are therefore described in greater detail. To make a
distinction from everyday forms of improvisation and to step away from a link to an idea
of emergencies or threat called up by the term crises, the types of crises meant here are
further referred to as non-standard situations.

   Going deeper into improvisation, adaptation and experimentation by using dictionary
definitions and combining these with the ideas of change introduced above, more can
be said about what they entail. Both adaptation and improvisation happen in the face
of a non-standard situation and both are directed at adjusting a normal configuration
to make it work in the situation at hand. They differ in their level of reconfiguration,
with adaptation being less extensive than improvisation. Moreover, adaptation can be
premeditated, while improvisation is inherently spontaneous. Experimentation is different
from the other two in the sense that it does not necessarily imply a non-standard
situation. Experimentation can happen in the face of familiar situations. It implies an active
search for reconfigurations of existing normal practice. Moreover, it involves a process
of planning, performing and evaluating. Based on dictionary definitions, the following
definitions of adaptation, improvisation and experimentation in practice can be composed:

Adaptation: to adapt a configuration to fit a non-standard situation by slightly adjusting (familiar and/or unfamiliar) elements and/or their links.

Improvisation: to creatively invent a reconfiguration in the spur of the moment of a non-standard situation with what is conveniently at hand.

Experimentation: to think up, try out and reflect upon a reconfiguration.

Because adaptation and improvisation are so similar, they are from now on grouped under improvisation.

When talking about extensive reconfiguration, which is the type of reconfiguration aimed for in sustainable design, making a reconfiguration work through improvisation or experimentation is not the same as the everyday crises of routine that Reckwitz refers to; it is an iterative process that may require several performances and involving new recruits to the emerging practice. Being (dispersed) practices, carriers can have varying levels of competence in experimentation and improvisation. Additional complicating factor is the contradiction, indicated briefly in Chapter 3, of practices being both stable and dynamic. Practices can change through improvisation and experimentation, when unfamiliar elements and links are integrated into reconfigurations that are repeated and spread. However, at the same time, practices consist of complex configurations of elements that are in turn part of webs of practices that work. This creates a certain stability that makes them resistant to change. Introducing an unfamiliar element or link into this complex system may require (drastic) reconfiguration. Alternative responses to such a situation may be not to improvise or experiment, but to reject the unfamiliar element or link and continue business as usual, or even to abandon the practice altogether. In other words, making available unfamiliar elements does not mean that they will be integrated into performances or become part of the practice-as-entity. Reconfiguration – in a particular, desirable direction – is a process that takes time and effort and throughout which unfamiliar elements or links can be rejected.

Summarizing the previous discussion, facilitating extensive, desirable change in practices (which is taken to be an objective of those engaged in sustainable design) requires the introduction of unfamiliar elements and/or links, and their integration into reconfigurations through bodily performances. To make these performances work, existing structures need to be shifted and broken through repeated and iterative instances of improvisation and experimentation. Finally, to change the practice-as-entity, the reconfiguration needs to recruit more and more faithful practitioners, a process through which the reconfigurations itself will necessarily transform. Facilitating extensive reconfiguration in a desirable direction therefore requires:

- The introduction of unfamiliar elements and/or links
- Improvisation or experimentation
- Bodily performance
- Repetition, iteration and learning
- Continued monitoring and involvement

6.3 Integrating practice theory in design theory

Although practice theory has much to say about change, it has very little to say about how to deliberately 'design' change in a desirable direction. Fortunately, there is an extensive body of knowledge in the design disciplines that does deal with questions of 'devising courses of action aimed at changing existing situations to preferred ones' (Simon 1996: 111). In the empirical projects of this thesis, the requirements listed above were integrated into existing design approaches and in this process, these design approaches were transformed. The following sections will discuss three concepts from design and these processes of integration and transformation.

6.3.1 Participatory design

Participatory design is an approach to design in which 'the people destined to use the system play a critical role in *designing* it' (Schuler and Namioka 1993: xi, emphasis in original). Closely related is the concept of co-design. Co-design lets users, researchers and designers cooperate creatively so that they can 'jointly explore ideas and concepts, make and evaluate sketches and tinker with mock-ups or prototypes' (Sanders and Stappers 2008). Key points of co-design are the recognition that everyday people can become co-creators rather than just customers, and that users can contribute as experts of their own experience (Sleeswijk-Visser et al. 2005).

The idea of involving 'future users' as experts of their own experiences in the product development process resonates with the idea of reconfiguration. *Re*configuration requires knowledge of existing configurations as carried by current practitioners of a practice. Moreover, the idea of users as co-creators is reflected in the POPD manifesto's (Shove and Watson 2006) tenet that everyone is engaged in 'designing' practices as part of every life.

However, a difference lies in *what* is viewed as the unit of design. The term 'user' implies a product development process, while in practice-oriented design, not the product but the practice is central. Moreover, a practice is not 'used'; it is carried and performed. This also means that even when the 'design' is 'in use', i.e., when the practice has become accepted and is regularly performed, it keeps on evolving. Performers are thus not only involved in the reconfiguration or redesign of the practice, carriers continuously redesign the practice through performance. In other words, practice-oriented design is inherently participatory. This position follows the observation by McHardy et al. (2010) that design 'does not lie in the hands of a single actor, but is instead distributed between multiple participants'. Additionally, if a product is developed in the process, the design of this product is also viewed as inherently participatory; what a product is, its meaning and how it is used is partly determined in practice. In this sense, the term participatory design, when used in a practice-oriented context, is a tautology. Taking practices as a unit of design implies a process inherently involving carriers of the target practice.

6.3.2 Prototyping

Design students are trained not only to communicate their ideas in words, but also in visualisations and physical form. These representations have several functions and several names in design theory. Here, 'prototypes' is used to group them. Hartmann et al. (2006) describe prototyping as 'a series of interactions between the designer and the design medium — sketching on paper, shaping clay, building with foam core', and view it as an essential part of successful product design. According to them, prototyping 'affords unexpected realizations that a designer could not have arrived at without producing a concrete artefact'. Prototyping is commonly connected to participatory design, where user involvement in the design process is facilitated by the communication of design ideas through prototypes in different stages of development (Svaneas and Seland 2004, Sanders and Stappers 2008). Prototypes used in the earlier phases of the design process are mostly generative, exploring how something could work, while in later phases the goal of making prototypes is mainly evaluative, assessing whether a product works as intended. Throughout these stages, prototypes develop from low-fidelity to high-fidelity.

Returning to practice-oriented design, the idea of prototyping relates to the idea of change through bodily performance and reconfigurations as emerging from performances. However, the prototypes generally referred to in design theory are prototypes of physical objects. In practice-oriented design, this concept is extended towards proto-practices, which include stuff, but also images and skills. A proto-practice or practice prototype is a worked out idea or suggestion of how things could be (in terms of configurations of images, skills and stuff). A practice prototype is performed, not used (in a performance). Importantly, a proto-practice, as opposed to a practice, is a configuration that does not work (yet), has not (yet) spread, and only works in a protective incubator environment (like a particular research situation). Like a product prototype, a practice-prototype can evolve from generative to evaluative and be low-fidelity or high-fidelity.

6.3.3 Iteration

Continuing on this idea of development from low- to high-fidelity, according to Roozenburg and Eekels (1998: 22), product development is an iterative process in which designs grow in subsequent cycles from vague ideas to concrete plans. A recurring theme in design theory is the idea that the type of projects designers (as opposed to for example natural scientist) tackle are wicked or ill-defined problems (Cross 1982, Rittel and Webber 1973), which do not have one solution or answer but rather a range of possible solutions. Therefore, understanding of the problem alone is not going to lead to a 'solution' or answer. That is why designers, according to Lawson (1979), use a 'conjectured solution' to define and redefine the problem at hand. This leads to an iterative refinement of what Cross (1982) refers to as abstract requirements and concrete objects.

The idea of iteration in design resonates with the idea that making an extensive reconfiguration work may require several cycles of improvisation and experimentation. In practice-oriented design however, there is no clear end point to the process. Practices

are never 'finished' or ready, they keep on evolving in various directions. As the POPD manifesto states:

> 'POPD never ends! POPD is implicated in the long term evolution of practices. POPD refutes the temporal linearity of contemporary product design. POPD does not end when the product sits on shelf. That moment is but one in the POPD'ers ongoing relationships with the practices in which they intervene.' (Shove and Watson 2006)

A configuration that works at one point in time, is likely not to work anymore in the future, simply because practices and the web of practices they form part of continuously change. A certain desirable configuration (i.e. with desired level of resource requirements) may work at one point, but ongoing involvement of the designer and subsequent interventions can be required to maintain this desired level of resource consumption on the longer term. Rebound effects, trends and varieties in performance will occur, but cannot be predicted. Therefore, the practice-oriented designer needs to keep track of these emergent developments in the target practice and possibly respond with additional interventions. In this light, the idea of solutions is not appropriate. In a practice-oriented view, the 'problem' of high and growing household resource consumption is not something that can be 'solved'. Both the 'problem' and the 'solution' depend on the particular situation and viewpoint taken, and are subject to continuous change.

6.4   A model for taking practices as a unit of design

In the empirical projects, the adjusted concepts of participatory design, prototyping and iteration were integrated with the requirements for taking practices as a unit of design summarized in Section 6.2. Five projects were conducted in which practices were taken as a unit of design. They entailed different levels of refinement of proto-practices. The set-up and results of these separate projects are presented in Chapter 7 and 8. These have been described in several earlier publications, which are summarized here together with the section numbers in the empirical chapters:

- experiments in practice (7.3.1) (Scott et al. 2011; Kuijer and De Jong 2011)
- trigger-product study (8.3.1) (Kuijer and De Jong 2012)
- try-it-out experiments (7.3.2) (Karakat 2009)
- generative improv performances (7.3.3) (Kuijer et al. 2013)
- prototype field studies (7.3.4)

All except for the trigger-product study were part of the bathing studies, exploring concepts around bathing with contained water. The trigger-product study explored person heating as part of practices of staying warm at home.

Reflection on these five generative, empirical projects helped define a general cycle for an iterative approach to taking practices as a unit of design, which is visualised in

Opportunities for
desirable change

Suggest
and trigger

Facilitate
performances

Combine,
evaluate and
refine

Reconfiguration
that works
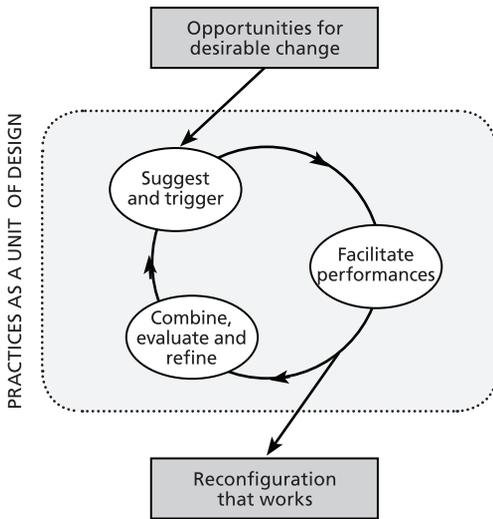
Figure 6-3 A model for taking practices as a unit of
design to move from opportunities for intervention
to reconfigurations that work.

Figure 6-3. The three activities in the
cycle – suggest and trigger, facilitate
performances and combine, evaluate and
refine – are further explained below taking
the perspective of the designer.

Opportunities for change

Before going deeper into the three
activities of the cycle, first a brief note on
the starting point of the iteration process.
In the analysis of the target practice, it
was concluded that the target practice
is currently not changing into desirable
directions and opportunities for desirable
yet plausible opportunities for intervention
have been identified. In the empirical
projects, these were 'a shift from flowing to
contained water (without immersion)', and
'supplementing space heating with more
person oriented forms of staying warm'.
Such opportunities form the starting point
for the generative phase of the practice-
oriented design process and the outlines of
a first, low-fidelity practice prototype.

6.4.1   Suggest and trigger

Core in this part of the cycle is preparing increasingly refined practice prototypes to
be suggested to performers in a way that triggers (extensive) experimentation and
improvisation. Drawing on the five generative projects, this section will first go deeper
into ways of presenting practice prototypes to study participants and secondly, elaborate
in triggering experimentation and improvisation.

Suggesting a practice prototype

In the empirical projects, proto-practices were presented to participants in the form of
explanations, images and artefacts. First of all, what became clear is that a predetermined
opportunity or direction for change is not a requirement to start a cycle. A generative
cycle can start by triggering experimentation, without suggesting a reconfiguration, which
was done in the experiments in practice study. When suggestions for a proto-practice are
made, the designer can choose to make them low- or high-fidelity, and to make them
more or less forceful.

A high-fidelity prototype is fleshed out in detail and contains a rich description of
elements and their links. A low-fidelity prototype, on the contrary, only contains a rough
and vague idea of a reconfiguration. Figure 6-4 explains this difference visually.

Low-fidelity practice prototype

High-fidelity practice prototype

familiar element

unfamiliar element
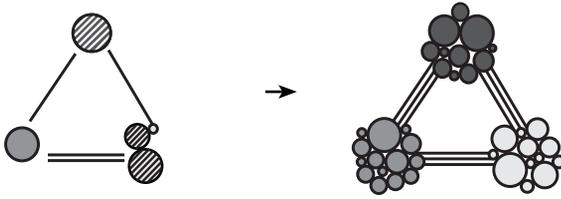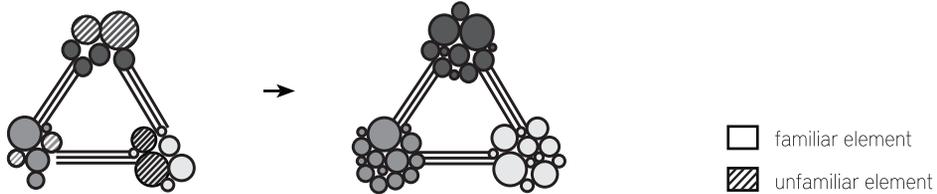
Figure 6-4 A low-fidelity and high-fidelity practice prototype that is brought into existing configurations.

However, the distinction is not straightforward. A proto-practice can be high-fidelity in some aspects, but low-fidelity in others. In case of the trigger-product study for example, participants were offered an existing product (a cherry stone pillow), including its packaging and user manual. Especially the latter were quite specific about ways of (skills) and reasons for (images) using the product (stuff), including references to other products such as microwaves and pillow cases. In this sense, the proto-practice was high-fidelity. However, interest in the study was not in the practice of person heating itself, but in person heating as part of the broader practice of staying warm at home. This relation was only roughly prescribed by asking participants to use the product as 'a way to keep warm (e.g., when working, watching TV or sleeping)'. In that sense, the practice prototype suggested in the trigger-product study can be considered as low-fidelity. Important in this respect is to note that a proto-practice does not have to contain new artefacts (product prototypes). A suggested proto-practice can involve the use of things unfamiliar to the target practice but already available 'in the market'. This use of existing products happened in the trigger-product study where participants were offered the cherry stone pillow. The try-it-out experiments study went a step further in this respect by instructing participants to (experiment with washing from a bucket and) make use of things they already had at home, such as buckets, sponges and cups. When doing this, however, as became clear in the trigger-product study, the designer has to realise that a consequence of using or offering existing products is that they are already part of existing, (high-fidelity) practices. Buckets have connected to them a set of skills, constraints and associations that may conflict with those in bathing for example.

Apart from being low- or high-fidelity, the proto-practice can be presented as an open suggestion on what the participant could do, feel, use, and why, or a more forceful suggestion. The latter can be done in terms of rules and explicit instructions on what the participant should do, feel, use, or even what not to do, feel or use. Again, the same proto-practice can contain a combination of the two. The try-it-out

experiments, for example contained open suggestions, like 'you may use [a mug to pour water over yourself]', and 'the way you [apply soap] is left up to you', but an explicit instruction was to use a bucket of water. The generative improv performances (GIP) study (Kuijer et al. 2013) contained explicit rules, in a format borrowed from improvisation theatre, like 'imagine that [splashing] is your normal way of [bathing] with which you are satisfied' and 'you cannot use [a shower hose with flowing water]'. But the foam product model used in the GIP study was deliberately left 'open'. It has to be mentioned that even the most forceful suggestion leaves space for variety in performance, and that high-fidelity prototypes aren't necessarily more forceful than low-fidelity ones. For example, participants in the GIP study did find ways to use (abundantly) flowing water and although high-fidelity, the splash prototype in the field studies (Section 7.3.4) was particularly designed to allow for a variety of ways of use and interpretations, and was indeed used and interpreted in highly varying ways.

As shown in the examples above, a specific type of instructions in these studies were instructions on how to feel. Different from studies in which ways of feeling are viewed as something to be discovered (e.g. in studies on product experience (Desmet 2005, Hassenzahl 2010), ways of feeling in a practice-orientation are considered as part of the practice and can thus be part of the practice prototype. In the GIP study for example, participants are instructed to feel satisfied, and in the prototype field study, instructions include the recommendation to enjoy soaping your body and pouring warm water over yourself. Note that these instructions do not imply that people can be instructed how to feel; actual ways of feeling emerge only from performance. But this counts for the entire proto-practice; it is a suggestion because it is meant to be transformed in performance. Besides suggestions on what to use, do and feel, practice prototypes can also offer suggestions on what to say. In other words, any practice comes with a certain vocabulary. The practice prototype can offer suggestions for this vocabulary in the form of names of the practice, product parts and actions. In the splash projects for example, splash and splashing were unfamiliar vocabulary (for showering) that were introduced to participants through the practice prototypes, just like product parts such as a basin, a hand shower and a scoop, or actions like pouring, squeezing and soaking.

Finally, practices are carried by people. Generally, the designer is more familiar with the proto-practice than the participants are, and over time becomes increasingly so. Looking for clues about how the suggested practice is constituted, participants in the studies therefore tend to view the designer as a carrier of the proto-practice, and as a source of information about it. When in direct contact with participants, explanation of the proto-practice from own experience can be an effective way of presenting it, but the designer has to be aware of the possible effects of such explanations and the way they are offered in steering the performances. Discursive explanations are for example much more difficult to control, so the proto-practice may be presented to different participants in different ways. To prevent this, the GIP study made use of a strict, written protocol to instruct all participants in a similar way. In the prototype field studies, the experience of the author with splashing was used especially in recruiting participants. It was difficult to recruit people and talking about splashing from direct experience greatly helped to convince people to try it themselves.

Triggering (extensive) experimentation and improvisation

In order to overcome the inertia of existing practices, a proto-practice should trigger non-everyday instances of improvisation or experimentation. Successfully triggering experimentation and improvisation is important, especially when a generative mode is required and the goal of the study is to find out *how* things could work rather than *whether* the suggested proto-practice works with the desired level of resource consumption. In the empirical projects it became clear that, as expected, extensive experimentation and improvisation are difficult to trigger. In the studies, participants were triggered through different types of tasks and settings. They included: removing essential elements or links from the current practice or problematizing it, guiding participants to take a distance from and critically view the practice they carry through self-analysis or by taking them out of their everyday contexts, and involving participants particularly skilled at improvising. Each is further explained below.

First, the setting of the study in itself triggers experimentation and improvisation. In the experiments in practice study for example, participants indicate participation in the study as a justification for uncommon behaviour. This 'acting out of the ordinary' as part of participating in a study was catalysed by the blog. Participant 9, for example experimented with not washing her hair, but expresses on the blog that 'if it wasn't for the experiment I would never dare to try something like this'. The blog also formed a particular place to express successes. In her second post Participant 3 proudly exclaims 'Jippii, I managed to have no shower this morning, just washing at the sink. And it feels good'. A remark she is less likely to have made to her colleagues at work that day.

While triggering reconfiguration has so far been suggested to entail the introduction of unfamiliar elements, the mere removal of a familiar element or link can also trigger reconfiguration. An extreme example could be to cut households from their electricity supply. It is easy to imagine that this would require extensive improvisation. The empirical studies did not involve such extreme measures, but in the prototype field studies for example, participant's regular showerhead was removed during the time of the study and in the trigger-product study, some participants were asked to turn down their thermostat by one or two degrees.

A related form of triggering is problematizing the current practice. This was done in three of the five studies by either positioning current practices as too resource intensive, or presenting the proto-practice as a 'better', less resource intensive alternative. Interestingly, in the experiments in practice study, several participants used the argument that their way of bathing was already 'sustainable' as a justification for doing non-extensive experiments. The following quotes illustrate this point.

> Participant 6: 'I always have very short showers [5 min.] already so I will focus on minimizing the amount of soap/shampoo.' [note: this participant takes 9 showers per week]

> Participant 16: 'I have no idea what type of experiment to do, my shower is already very short [5-12 min.] and I use environmentally friendly soap.'

These participants circumvented (extensive) experimentation by explaining how they had already (adequately) responded to the problematization suggested. What this response illustrates is a risk related to problematizing the level of resource consumption of a practice. Because it is quite common in daily life (in the form of for example campaigns trying to make people aware of environmental problems), people have developed strategies to cope with it. In the case of bathing for example, the common response to concerns about its water intensity is to reduce shower durations (and not shower frequencies). These strategies, and thus the problematization of resource intensity have, over time been integrated into the practice. In that sense, problematization of levels of resource consumption will, in many cases not be unfamiliar to the current practice and is therefore unlikely to disrupt it.

Participants can be also triggered to experiment by guiding them to take a distance from the practices they carry and view them critically. In the experiments in practice study, participants were guided to unravel bathing (in the elements of images, skills and stuff) and by tracing it back in time (through going back in their personal bathing history and through interviews with previous generations). What this comes down to is a micro scale version of the analytic model proposed in Chapter 5. However, achieving an overview and critical distance in a short time span and from an individual perspective turned out to be very difficult. As a consequence, opportunities identified from it (the experiments) tended stick to the existing practice of (daily) showering, for example by reducing the use of cosmetics or shortening shower time (see Table 7-3).

Focusing on the stabilizing effects of existing structures, another way of catalysing extensive reconfiguration is taking people out of the context their familiar routines, norms and things embedded into complex configurations that work. In the Generative Improv Performances (GIP) study (Kuijer et al. 2013) for example, participants were invited into a simulated bathroom space in a university lab. The lab was expected to form a setting where acting out the ordinary is easier than at home. However, this isolation of practices from their everyday context can also be seen as a weakness of the approach. Besides missing potentially important links with other everyday practices, GIP can only be applied to practices that can be isolated in such a way. This excludes for example practices such as staying warm because they involve a range of practices that are dispersed in time and over the home. Addressing this limitation, a possible avenue of further research may be the use of GIP in a Living Lab setting (Bakker et al. 2010), where the lab comprises an entire dwelling and performances span several days or more. Section 8.3.2 describes a pilot of such a study.

Again striving for extensive reconfigurations, the GIP study sought the involvement of trained improvisation actors. While in literature on improvisation theatre, improvisation is recognized as a general human skill (Sawyer 2000), with an important role in societal change (Frost and Yarrow 1990), this literature also makes clear that improvisation is not easy to do, and that skills of improvisation can be enhanced through training. Seham (2001) summarizes these skills as 'a mixture of "making do" and "letting go"'. Making do refers to skills of 'using bodies, space all human resources, to generate a coherent physical expression of an idea, a situation, a character' (Frost and Yarrow 1990) while 'permitting everything in the environment (animate or inanimate) to work for you' (Spolin 1999), and letting go to the ability to 'free oneself from socially accepted frames of reference and

assumptions of expected behaviour', to 'focus on the process and suspend judgment of the outcome' (Vera and Crossan 2004). Trained improvisation actors are therefore particularly skilled at forming extensive reconfigurations of practice through bodily performance. It has to be noted that involving improvisation actors also has limitations, especially in the practical sense of finding willing participants both familiar with the target practice and trained to improvise.

6.4.2   Facilitate performances

When taking practices as a unit of analysis, performances turned out to be central. This observation clearly resonates with for example the work of Scott et al. (2011) in their paper titled 'Designing Change by Living Change'. In the approach they are viewed as the locus of where suggested, desirable proto-practices are rearranged into configurations that work. Important tasks for the designer in this part of the cycle are facilitating a variety of performances and documenting these performances for the next phase.

Facilitating variety
Variety in performances can be achieved on two dimensions: through recruiting various participants and by having each participant perform several times. These two dimensions of variety are presented in Figure 6-5. In the studies, numbers of performers varried from two to sixty, and numbers of performances per participant from one to fifteen.
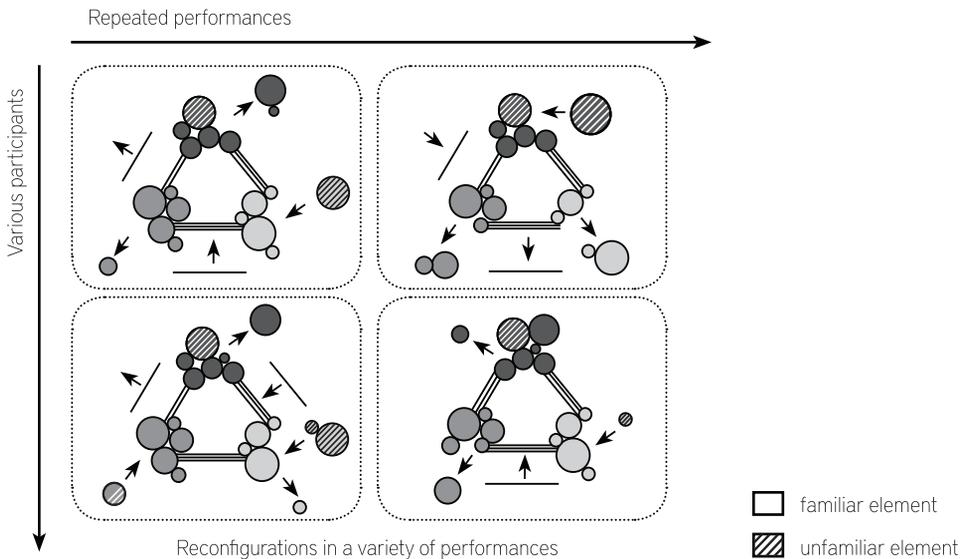

Figure 6-5 Variety in performances on two dimensions.

Repeated performances by the same participant allow for fleshing out of the reconfiguration by trying different alternatives and recruiting a variety of additional elements into it. Participants reflect on their performances and adjust them to make them work. For example, one of the participants in the prototype field studies explains how she made splashing work for herself:

> 'at first I thought what to do with this strange object in my bathroom, but then I saw him [her son] enjoying it and I started to play with it as well. You have to cross that line at first, but then you play with it and try it out, and then you can develop a way that works for you. That takes some time.' (Astrid)

Repeated performances also allow for less deliberate bodily and mental learing processes to take place. In the experiments in practice study for example, Participant 9, whose experiment is to stop using shampoo, explains how her hair at first got so greasy that she doesn't dare going out anymore without covering it. In the second week, it starts to become 'really ok'. Her hair becomes less greasy and when she wets it, it now feels 'a bit smooth'. And Participant 3, who switched from shampoo and shower gel to ghassoul (a mineral soil for washing), explains that she got used to the different feeling over time: 'First I still felt dirty after the shower, but now it is feeling normal'. Apparently, this learning (and unlearning) happened over the course of less than a week.

Because different participants have access to different 'libraries' of elements and links that can be integrated into the reconfiguration. the more different the backgrounds of the participants, the more different the libraries avaiable to them. Something else that differs between participants (even when carriers of the same practices) is the kinds of configurations that will (or will not) work for them. Diversity between participants can be increased by recruiting for high variety in types of performers. It is however difficult to judge how performers will be different and much depends on the practice. While for example recruiting participants with different cultural backgrounds turned out to be helpful the GIP study, it also became clear that participants who seemed very similar in terms of socio-cultural background, like for example Bas and Anton in the prototype field studies, can have very different ways of performing and responses to the proto-practice. In a practical sense, because it has been difficult to find participants at all in most of the studies, being selective was hardly possible.

High variety in performances is desirable in the earlier cycles of development of the proto-practice. In later cycles, coherence and the creation of a shared practice is more desirable. As a general rule, few performances by many participants result in greater variety than many performances by few participants. Therefore, later cycles in the process benefit from fewer participants performing more often.

Documenting performances

For the designer, a challenge lies in documenting performances in a way that is valuable for further development of the proto-practice. Challenges are similar to those of studying existing household practices as described in Section 5.4.1., but there are also differences. Ways of documenting performances in the empirical projects are discussed according to the three main sources of information about practices explained in Chapter 5, being

bodily performances, practitioner's rationales and material artefacts. Again, the focus is on accessing the (proto)-practice-as-entity.

Compared to analysis of current practices, detailed information about single performances of the proto-practice is much more important. The reason is that in the case of proto-practices, there are relatively few performances, so each performance represents an important share of the practice-as-entity. The challenges of observing performances are mostly the same though. Bathing is performed in private and therefore difficult to film, and staying warm at home is strongly dispersed in time. Therefore, the designer has to primarily rely on participants' accounts in interviews. A helpful difference is that these performances are not (yet) routine, and therefore tend to be remembered in more detail by participants. Like in the analytic studies, a tool used to support memory were diaries. The try-it-out experiments study, for example, asked for a detailed process description, offering an example of brushing teeth in fourteen steps. The trigger-product workbook offered a table to fill in detailed actions and times. While workbooks were filled out rather diligently – most workbooks in the trigger-product study contain at least a couple of entries in the table, and some even drawings (Figure 6-6) – they were always combined with interviews. In the interviews, participants were questioned at length to uncover exactly what they did in their performances in as much detail as possible using strategies similar to those described in Section 5.4.2.

In several studies, documentation went beyond self-reporting and discursive interviews. In case of the Generative Improv Performances (GIP) study (Kuijer et al. 2013), it was possible to film performances because of the lab setting and the fact that participants were dressed. In the trigger-product study, post-interviews were videotaped and participants were asked to re-enact several scenes from their performances. Finally, the water logger used in the second prototype field study provided detailed information


Figure 6-6 Example of documented actions in a trigger-product workbook (Participant 4: Blokhuis and Bothun).

of a particular aspect of the performances that helped obtain an image of performances without being too intrusive.

Compared to current practices, rationales related to proto-practices were easier to access because it was easier for the interviewer to adopt the role of a novice. In further stages of the research however, the role of novice became more difficult to keep up. In the field studies for example, participants viewed the author as an expert practitioner. In such cases, it turned out to be useful to ask participants how they would explain the proto-practice to an outsider or how they compared the proto-practice to the target practice. Another way of collecting data on the rationales and positioning of the proto-practice was by documenting exchanges between participants. This was for example done in the experiments in practice study, where participants could communicate on a blog and came together in a joint workshop.

A third source of information was formed by the material settings of the performances. Participants were asked about the things they used, and what things they didn't use but would like to use. In the try-it-out experiments they were asked to take photos and make drawings of the settings of their performances and in the trigger-product and prototype field studies, these settings were directly observed and documented by the designer (Figure 6-7).

A particular material aspect of the proto-practice was that resource consumption per performance required documenting. In the experiments in practice and try-it-out studies, participants were asked to self-report their water consumption. The trigger-product study did not quantify resource consumption. In the GIP study, no actual water was used, but imaginary consumption was estimated on the basis of analysis of the videotaped performances. In the prototype field studies, aggregate water consumption was measured and later water consumption per performance for the basin and hand shower were logged separately.
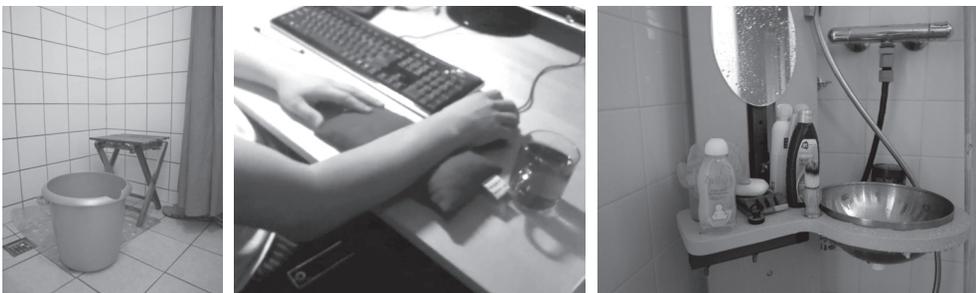
Figure 6-7 Pictures of material settings from the try-it-out experiments (Karakat 2009), trigger-product study (picture: Marsman and Kwon 2010) and the prototype field studies. (FamA) .

6.4.3 Combine, evaluate and refine

The redesign entails combining all different performances, taking each as valid and designing a configuration of elements that allows for the widest variety of performances, a type of open design.

Combining performances

The first step in analysing the set of performances collected in the previous step is to, if the level of detail in data allows, describe each performance separately in a corresponding format. Except in the GIP study, where each performance was filmed separately, what turned out in the studies to be realistic however, was to describe the aggregate of performances for each participant into the form of a coherent proto-practice (Figure 6-8). Such a format can be a table, a narrative or in case of the GIP study, graphical overviews.

The next step is to get an overview of the ranges of variety that occurred by selecting a number of variables on which similarities and differences in the performances can be described. Variables can be sought in what was done, used and felt, in rationales for doing and feeling, in the amount of resources consumed and so on. This can be in the form of discursive descriptions for a number of themes as in the trigger-product study for example, or in the form of a table as in the GIP study.

familiar element

unfamiliar element
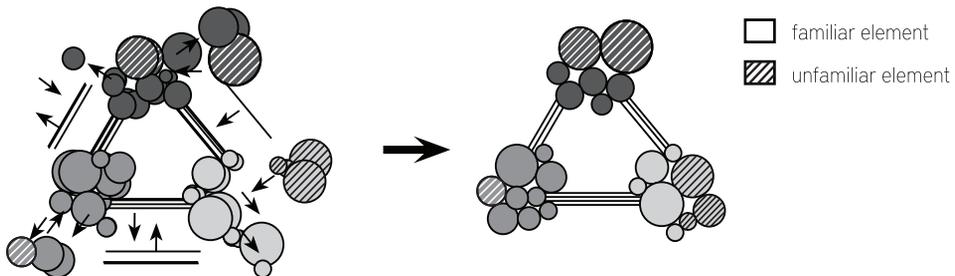
Figure 6-8 Grouping a variety of performances into a coherent proto-practice.

Because variety reduces with advancing cycles of practice development, grouping and comparing performances becomes easier. In the experiments in practice study for example, experiments differed strongly and some varieties were performed by one participant only. In this study, performances were grouped into five different strategies for reducing resource consumption. Some containing several varieties, such as washing from the sink and washing from a bucket. In the splash field studies, variety between performances was also high, but on a different level.

Evaluating performances

In the empirical studies, performances were evaluated on two main aspects: do they work (or have potential to work) and do they have the desired level of resource consumption. Situated within the context of sustainable design, the practice-oriented approach is clearly normative, meaning that it harbours a clear idea of more and less desirable directions for

change. However, its foundation in practice theory also means that judgement of whether a performance works emerges from performance, so judging whether a practice works can only be done in performance.

A reconfiguration that works is repeatable beyond the specific situation of single performances, i.e., it has potential to become more widely reproduced and recruit well. However, if a reconfiguration is rejected after performance as not repeatable, or even before performance, this does not necessarily mean that it doesn't work. It means that it does not work in that situation. Therefore, judgments whether the proto-practice works become more realiable when it is integrated more in daily life and performed more often. Conversely, if a proto-practice works in a certain situation and is thought to be repeatable by the participant, this does not necessarily mean that it will work beyond that situation. In brief, the designer has to realise that whether a reconfiguration works depends on who is asked what, when, where and how.

Nevertheless, if a proto-practice is performed repeatedly by a participant and evaluated positively, this can be considered a strong indication that it works for this person. If there are several people who evaluate the proto-practice positively after repeated performance, this is an even stronger indication that it could work as a practice. However, as long as the practice does not become a normal way of doing for a considerable group of people, the questions whether it works cannot be answered. As long as it has not spread widely, it therefore remains referred to as a proto-practice. In any case, a practice never works for everyone indefinitely, so whether a practice works always requires the disclaimer of 'currently' and 'for those who regularly perform it'.

Judging the level of resource consumption involved in performances can be done by the designer by comparing the (estimated) level of resource consumption to the target level set in the analytic phase. As became clear in the staying warm projects, what can also result is an indication of clearly undesirable directions in which the practice could develop as a consequence of an intervention.

Refining reconfigurations
Based on the evaluations of the performances, refinement of the proto-practice focuses on ways in which participants judge it not to work for them, and by focusing on those performances with lower resource requirements.

To be clear, refinement of the proto-practice is about more than addressing dislikes or inhibiting undesirable directions through adjustments in technologies. Although this strategy is the first response of a product designer, a practice-oriented approach expands the unit of design to practices, thus involving not only stuff, but also skills and images. Consequently, a proto-practice does not necessarily involve the introduction of new stuff at all; it can be merely adjustments to images and or skills, facilitating or inhibiting the making of links, or even involve the removal of things from existing configurations. From the performances in the bathing studies it became clear that it (splashing) was by some participants experienced as slow or a hassle, while others found it relaxing and particularly appreciated the deliberate body care it entailed. In the refinement of the proto-practice, these latter qualities were emphasized in the visual, physical and discursive presentations of the proto-practice to new participants. What also emerged from these studies is that along with new skills and stuff involved

in the configuration (such as pouring, scooping, scoops, seats and basins), splashing required a new vocabulary. This new vocabulary was offered to participants in the form of written and discursive instructions and descriptions of splashing.

Additional strategies for refining a reconfiguration to make it work used in the empirical projects were allowing for variety and allowing for learning processes to take place. In each study, high variety was found between performances, sometimes differing diametrically. For example, some participants particularly appreciated the possibility to sit down while splashing, while others particularly rejected the idea of sitting. Acknowledging both these judgments as valid, splashing allows for use in both sitting and standing postures. Another observations was that compared to showering, splashing requires different bodily and mental skills, such as ways of setting the right water temperature in the basin, managing the clearness of the water in the basin, enjoying the feeling of splashes of water on the body, getting used to sitting down naked, managing body temperatures. These bodily and mental skills require time to be learned. Instead of making the practice instantly optimal in terms of use experience, the design is such that it attempts to allow for learning to take place over the course of subsequent performances.

All these refinements are aimed at making the proto-practice work. However, even though the designer becomes increasingly skilled at making predictions about whether configurations would work or not based on earlier experiences, whether a refined reconfiguration works and has desirable levels of consumption can eventually only be judged through (repeated) performances. Therefore, as a next step, the refined proto-practice is prepared to be fed back into another round of performances.

Through a series of iterations, the process thus evolves from a focus on triggering and disrupting current practice, to incubating potential reconfigurations, to scaling up these reconfigurations to form a desirable reconfiguration that works. However, even then the designer is not finished. Because practices are constantly changing, they may again move in undesirable directions requiring another designed intervention.

6.5   Conclusions

The aim of this chapter was to provide an answer to the question 'What does it mean to take practices, instead of interactions as a unit of design in sustainable design?'. As in Chapter 5, the recommendations made above form a possible answer to the methodological aspect of this question. From these recommendations, it becomes clear that the generative activities in a practice-oriented approach differ from those in an interaction-oriented approach in a number of respects. Basically, these differences are captured in the questions lying at the basis of the two design approaches. While in interaction-oriented approaches the question is 'how to motivate, persuade or steer people to adopt sustainable behaviours through product interventions?', the question at the basis of a practice-oriented design process is 'what could be less resource intensive reconfigurations that work?'. Consequences of this difference can be explained starting from the contradiction, illustrated in Figure 6-9 that in practice-oriented design intervention in practice is a starting point of the process, and a desirable reconfiguration of the target practice an outcome, while in interaction-

Interaction-oriented design

Sustainable → Design → Intervention
behaviour   process   in practice

Practice-oriented design

Intervention → Design → Desirable
in practice   process   reconfiguration

Figure 6-9 Differences in starting points and outcomes of the design process.

oriented approaches, a certain vision of 'sustainable behaviour' is the starting point
and an intervention in practice (also referred to as a 'solution') the outcome.

First of all, this difference says something about where the locus of design activity is
viewed to lie in both approaches. When broadly defining designing as the creative act of
generating what could be, as opposed to what currently is, the practice-oriented approach
proposed in this thesis views performances as the place where 'designing' happens. It thus
acknowledges that an intervention in daily life requires redesign of the existing practice
and web of practice it is part of. In the interaction-oriented approach, 'designing' is viewed
as something that happens as separate from daily life. A consequence of this difference
is that in practice-oriented design, the intervention is disruptive and deliberately intended
to lead to a non-standard, challenging situation in which extensive reconfiguration is
required. In interaction-oriented approaches on the contrary, the designer strives to make
the intervention as 'smooth' as possible to make it 'fit' into existing configurations. The
difference between a disruptive and a 'smooth' intervention is that the first does not
intend to 'work' immediately. Another difference lies in what is designed. In interaction-
oriented approaches, specific ideas of 'good' or 'sustainable' behaviour form the point of
departure for the design process, while in the practice-oriented approach, reconfigurations
are viewed as something that emerges from the design process. In this process, the
designer takes the role of facilitator and catalyser.

This difference between 'sustainable behaviour' and desirable reconfigurations or
directions for change incorporates another important difference between the approaches.
The static idea of behaviour, incorporated in the term sustainable behaviour directly relates
to the pursuit for optimization prevalent in interaction-oriented sustainable design. This
pursuit is criticized in the more general area of user-centred design by Redström (2006).
Observing a tendency to optimize fit between object and user, Redström expresses the
concern that 'to fit means to fit something at the expense of something else'. Combined
with the idea that practices are internally differentiated and dynamic, optimization of
a design towards one scenario narrows the appropriateness of the design for other
scenarios. Or more strongly, investing in one particular, optimal scenario will correspond
with few or even no actual performances. However, there is another, more harmful
downside to this endeavour for optimization. As Redström states:

'As the possibilities for alternative interpretations are systematically reduced as a result of the designer's attempt to optimise the design with respect to fit, the room for finding our own solutions, possibly coming up with interpretations that are more interesting than the original intent, is reduced to a minimum.' (Redström 2006: 135)

Combined with the rhetoric of 'good' and 'bad' behaviour, these designs have the risk of imposing (a term used by Jones (1988)) upon people certain forms of conduct that are determined unilaterally by designers. Moreover, combined with the pursuit of ensuring a fit to existing attitudes and norms, these forms of conduct are based on an existing, arguably undesirable, status quo. On the contrary, practice-oriented design does not invest in optimal scenarios. A practice-oriented approach strives for a form of open design in which variety and change over time are facilitated. Similar to the idea of 'match just enough' proposed by Zakkas et al. (2011), it seeks a 'balance between anticipating and steering an experience, and leaving free space for open interpretations, aberration and subversion'.

To illustrate this rather theoretical account, Chapters 7 and 8 illustrate how the practice-oriented approach proposed in Chapters 5 and 6 can result in suggestions for reconfigurations of resource intensive practices towards strongly less demanding forms that have potential to work.

Part III
Empirical projects

In Chapter 5 and 6, a practice-oriented design approach is proposed, consisting of an analytic and a generative part. This approach was developed through a series of related research and design projects on the topics of bathing and staying warm at home. The bathing projects are described in Chapter 7 and the staying warm projects in Chapter 8. These projects were either conducted by the author, or conducted by students in the Industrial Design Engineering program of TU Delft and supervised by the author. An overview of the projects and the researcher's role in each is offered in Appendix B.

In order to illustrate the practice-oriented approach in Part II, the projects are here presented in the proposed format. It is important to mention that since the proposed approach emerged from reflections on the projects, and was thus not known beforehand, the actual process followed in the projects was somewhat different. The figure in Appendix A gives some insight in the actual sequence of activities and their relations, which was much messier and haphazard than the 'ideal' form they are described in here.

7   Bathing

7.1   Introduction

Bathing – meaning all activities directed at washing the body, such as taking a bath, showering and washing at the sink – is a water and energy intensive domestic practice. Being relatively isolated both in space (to the bathroom) and in time, it has been a manageable and rewarding topic of study. The bathing related projects underlying this chapter formed the primary source of empirical insights in this thesis.

Following the approach presented in the methodological chapters, a distinction is made between taking practices as a unit of analysis (with a focus on what currently is) and taking practices as a unit of design (with a focus on what could be). Section 7.2 illustrates a search for opportunities for change in bathing practices following the analytic model presented in Chapter 5. Building on the results of this analysis, Section 7.3 describes the development of the opportunity thus identified towards a less resource intensive reconfiguration of bathing that works. The generative projects are described according to the cyclic model presented in Chapter 6 and comprise four iterations: experiments in practice, try-it-out experiments, generative improv performances and prototype field studies.

Framing the target practice

Before going deeper into the bathing related projects conducted within the context of this thesis, it has to be mentioned that they build on the master thesis work of Kakee Scott (2008). In her research, Scott has framed the target practice as bathing, which is by Merriam Webster defined as 'a washing or soaking (as in water or steam) of all or part of the body'. This choice of framing, although not explicitly discussed in her work, has

turned out to be vital for the projects. A more obvious choice, when looking at statistics and literature on water consumption might have been to frame the practice as showering. Showering is by far the dominant means of bathing in The Netherlands, accounting for 95% of water consumption (Foekema and Van Thiel 2011) and studies concerned with domestic water consumption predominantly focus on showering (e.g. Hand et al. 2005, Ravandi et al. 2009, Kappel and Grechenig 2009, Laschke et al. 2011). Scott's choice to focus on bathing instead has, from the onset of the projects questioned showering as a preferred way of washing the body, something that has clearly distinguished them from other efforts directed at reducing water consumption in the bathroom. Moreover, this choice, deliberate or not, reflects the disposition induced by a practice-oriented approach to look beyond averages.

7.2 Analysing practices of bathing

PRACTICES AS A UNIT OF ANALYSIS

Selected target practice

Quantify consumption indicators

Current average, variety, history and target level

Trace historic career

Explore similar practices

Map the target practice

Opportunities for desirable change
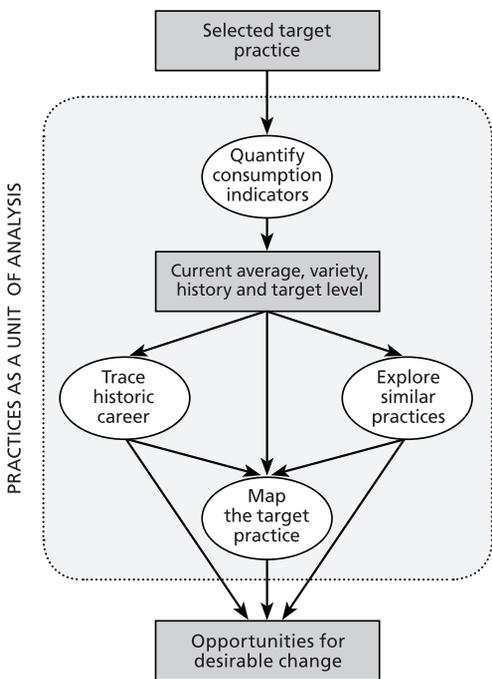
Figure 7-1 Model for the identification of opportunities for intervention in a selected target practice (circles represent activities, squares intermediate results).

In order to identify opportunities for desirable change, a practice-oriented analysis of bathing was conducted. Although it did not follow the approach presented in Chapter 5 exactly, results of the analysis will be presented according to the proposed model, which is included in Figure 7-1 for reference. Appendix A contains a chronological representation of the bathing projects.Following the model, the section starts with an overview of water and energy consumption involved in bathing from various angles. It then takes the reader back to bathing in Roman times and all the way to current bathrooms in India and Japan to end up with a fresh look at the Dutch shower booth. This fresh look results in the identification of the flowing water paradigm as problematic and the concept of bathing from (not in) a reservoir, which was repeatedly encountered elsewhere, as a likely candidate to replace it. The overview of bathing practices and the selected design opportunity thus identified form the starting point for the generative projects described in Section 7.3.

7.2.1   Quantifying consumtion indicators: water, energy and soaps

In unravelling bathing related consumption aspects, Scott (2008) lists three material groups that are consumed directly in the act of bathing, being clean water, energy to heat and pump the water and various products, notably soaps and shampoos. With this project's focus on direct resource consumption, consumption of soaps and shampoos as such will not be taken into account. However, since the use of them goes hand in hand with the use of warm water – each 250ml bottle of shampoo results in an average use of 218 litres (Hielscher 2011) – they are certainly relevant for the amounts of warm water used. Main indicators for bathing related resource consumption selected are therefore: water, energy to heat the water, and soaps and shampoos. This section presents an overview of current averages in consumption levels, variety from this average, historic developments and eventually a target level to reduce towards.

Water use

According to a 2010 study conducted among 1.200 Dutch households, average water use for bathing per person per day in the Netherlands is 51,4 litres, of which 48,6 litres is used for showering. On average, Dutch people shower 5 to 6 times per week and the average duration of a shower is 8 minutes. With an average flow of 7,7 litres per minute, the average amount of water used per shower is 62 litres (Foekema and Van Thiel 2011). Analysis of additional data on variety in shower frequencies and durations shows that shower frequencies vary from once a week (4% of participants) to twice daily (2% of participants) or more. Although the median frequency is 7 times per week (which does not necessarily mean daily), representing 31% of participants, 58% of the participants who shower do so less than 7 times per week[5] . Reported shower durations (comprising data of a Monday and a Saturday) vary from 1 minute to 55 minutes, with a median of 4-6 minutes (35% of participants); 54% have the tap open longer, 12% shorter than that.

Because shower frequencies vary so strongly and most people do not shower daily, reporting water consumption as a daily average gives a distorted image. Given the variety, it makes more sense to express consumption indicators in terms of weekly levels. Average weekly consumption of water for showering in the Netherlands is 340 litres per person. Figure 7-2 shows an approximation of the normal distribution of weekly water consumption.

Figure 7-2 Estimated distribution of water consumption for showering in the Netherlands per person per week (median approximately 270 litres, average 340 litres).

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[5] This is in contrast to a UK study, where 44% of 1750 participants bathe or shower 7 times per week, 28% more, and 27% less (Pullinger et al. 2013). Still, overall water use for bathing in the UK is a little less than in the Netherlands (49,5 litres per day)(Waterwise 2012).

To gain insight in the historic development of water use for bathing, Figure 7-3 roughly visualises the historic development of consumption per person per week from the times of the Roman Empire until today. It uses estimations for European averages based on historic accounts of bathing (Bushman and Bushman 1988, Stuller 1991) and specific data for the Netherlands recorded between 1970 and 2010 (Foekema and Van Thiel 2011; Geudens 2012). Although being a rough estimation, especially concerning the older metrics, this figure shows that water consumption for bathing was relatively high during the time of the Roman Empire and much lower during the Middle Ages until it started to rise again around the year 1600. Then, over a period of 400 years, average weekly water consumption for bathing per person increased from below 70 litres to over 340 litres. The rise was particularly strong between 1970 and 2000 and has somewhat levelled out today.
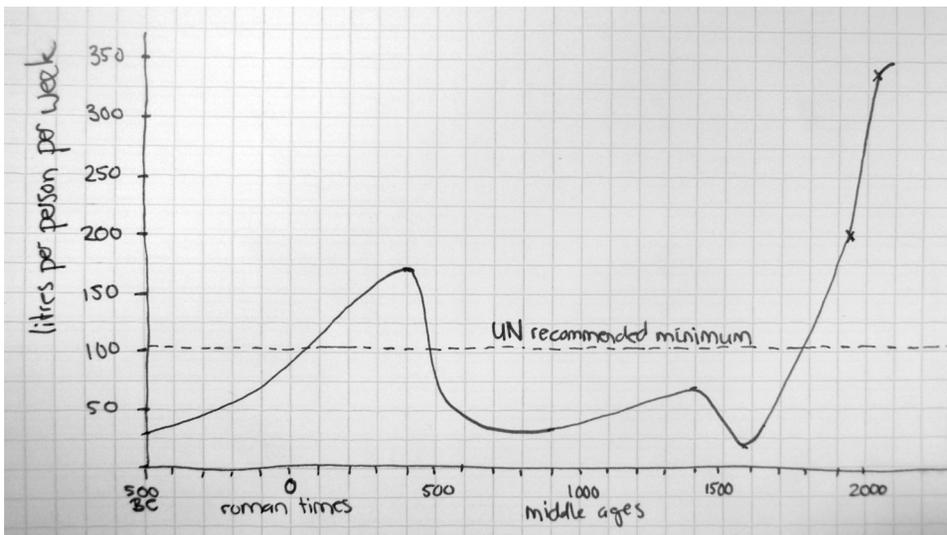
Figure 7-3 Estimated water use per person per day [convert to weekly] for bathing (500BC to present).

As shown above, water use for bathing in the Netherlands strongly varies between people and situations. At world level, however, variety in levels of water consumption is of an even larger magnitude, with the total of average water consumption per person per day varying from 575 litres in the United States, to 200-300 litres for most European countries, to 4 litres in Mozambique (UNDP 2006: 34). With such an overview, the question of basic water needs comes to the fore. What is actually enough water for survival or achieving a reasonable standard of living? Based on recommendations made by Gleick (1996), the United Nations employ a recommended minimum water use for bathing of 15 litres per day, translating to an amount of 105 litres per week. For reference, this number is inserted in the historic overview of water consumption per person per week in Figure 7-3.

Energy to heat the water

While the supply and processing of piped water requires energy, the most energy intensive aspect of showering is the heating of the water. This largely relates to the amount of water that is used, but also to the temperature to which it is heated. In the Netherlands, water from the mains has a temperature of around 10 to 13°C (Versteeg and Dik 2011). For heating one litre of water to 38°C (the shower temperature scripted into thermostatic taps) requires 117.040 Joules or 32,5 Wh. This means that the average Dutch shower of 62 litres requires at least 2 kWh or 7,3 MJ of energy, adding up to approximately 8,4 GJ per household per year; a value that should be multiplied by the efficiency factor of the heating system. In terms of the environmental impact of showering, heating of the water accounts for approximately 90% of CO_2 emissions (Knupfer 2011). However, because this form of energy use is mainly proportionate with levels of water consumption, water use is in this thesis used as a proxy for the total environmental impact of showering.

Soaps and shampoos

Data on soap and shampoo use suggest an average yearly usage of 14 bottles of shampoo and 15 bottles of body soap per household per year (Klashka et al 2007, Ferrer et al. 2012). This comes down to an average weekly consumption of around 28 to 42 ml per person for both soap and shampoo, with body soap consumption presumably somewhat higher than shampoo. Data on consumption trends in soaps and shampoos are difficult to find, but with the increase in water use for showering, the use of soaps and shampoos has also increased. In Germany for example, the consumption of shower gels has quadrupled between 1985 and 1993 (Klashka et al. 2007). Looking at variety, a small scale survey among 16 participants conducted for this thesis showed differences ranging from the use of soap a couple of times per week to twice in one shower (Kuijer and de Jong 2010).

Summing up, water consumption has steadily risen in the past 400 years to an average level of 340 litres per person per week. Zooming in on today's water use for bathing, this is mainly used for showering. Consumption metrics vary between Dutch consumers, but differences are even greater between different countries worldwide, with the average North American using 130 times more water than someone in Mozambique. The UN recommends 15 litres per day (105 litres per week) for bathing as a basic human need. This recommendation is used as a target level in the bathing projects.

To get an idea of what bathing requiring around 105 litres per week could be like, and how the shift could be made from today's mainstream practice to such a more desirable form of bathing, it is important to learn more about the less resource intensive varieties identified in this quantitative analysis. This will be done in the next two sections.

7.2.2   Tracing historic career: from the Roman Empire to Kira

The history of bathing can be traced back to far before the start of our calendar (e.g. Moses was found by the pharaoh's daughter while she was bathing in the river Nile), but this analysis starts with an era that was particularly famous for its excessive bathing habits: the Roman Empire. As Bryson writes, 'you cannot talk about baths without talking about Romans' (2010: 5).

Roman Empire

In his book Clean and Decent, Lawrence Wright explains that the Roman public bath 'was the focus of communal life' (Wright 1967). As such, bathing could be seen as a basic social duty. Although in the early days of the empire bathing was a weekly affair at most, the balneum (a small bathhouse) and later the thermae (larger and more elaborate facilities) were, at the height of Roman times, visited daily. Stuller describes what such a visit may have looked like:

> 'Baths usually opened at midday, just as sportsmen finished games or exercise. A bather first entered the tepidarium, a moderately warm room for sweating and lingering. The wealthy man brought slaves to anoint his body with fine oils, some of which included sand to help remove dirt. Poor folk scrubbed themselves with inexpensive lentil flour. Next came the calidarium, a hotter room for greater sweating, or perhaps the ultrahot laconicum. In these the bather doused himself with copious quantities of warm, tepid or cold water. Scraped off with a strigil, sponged and reanointed, the Roman concluded the process by plunging into the cool and refreshing pool of the frigidarium.' (Stuller 1991)

These elaborate bathing habits involved excessive amounts of water, something only possible because of the advanced plumbing technologies of the time. Stuller writes that in the fourth century, Rome featured '11 large and magnificent public bathhouses […], and many hundreds of private baths' (Stuller 1991). Altogether, estimations are that this resulted in a stunning per-capita daily water use of about 1100 litres. It has to be noted though that this water was not consumed (as in orally) and could thus be reused for several purposes.

Water use, however, was not the only thing that got out of hand in the Roman thermae according to Stuller. Over time, when mixed sex thermae became more common, baths became 'hotbeds of promiscuity and vice'. This development was one of the important reasons for the decline of bathing, when during the Middle Ages the church became more influential in daily life.

Middle Ages into Renaissance

Stuller (1991) cites Greene, a professor of epidemiology who states that 'the fathers of the early church equated bodily cleanliness with the luxuries, materialism, paganism and what's been called "the monstrous sensualities" of Rome', and commanded as little bathing as possible. Consequently, the Middle Ages have been typified as 'a thousand years without bathing', a label that was at that time carried with pride. Saint Francis of Assisi for example, considered an unwashed body a 'stinking badge of piety' and Queen Isabella of Castile (1451-1504) boasted that she had had only two baths in her life: one at birth and one before her wedding. Discouragement of 'over bathing' (i.e. more than once a month) was in some places even enforced by law (Stuller 1991). A thousand years without a bath is however a bit of an exaggeration, explains Stuller. Sunday baths were at times allowed and even recommended by the Church, as long as they did not become a 'time-wasting luxury'. Moreover, although not dousing in a bath or sweating in a laconicum, pre-seventeenth century etiquette guides did insist that teeth, face and hands

were to be cleaned each morning and shallow basins, water jugs and even bath tubs were found in most manor houses (Stuller 1991).

From the 11th century onwards, there was even a temporal revival of the communal bath in Europe when the crusades got inspired by the Islamic Hammam. Less elaborate than the thermae, Hammams also offered a series of rooms heated to different temperatures and were supposed to enhance fertility and support spiritual and physical purification. However, soon these so-called stews met with the same fate that had rendered the Roman baths so undesirable by the ruling classes. Reputations of sexual enticement combined with the not entirely nonsensical idea that stews contributed to the spread of infection and plague led to the closing of most public bathhouses during the 16th century. The connection between disease and bathing was very effective in reducing not only public but also private body washing. The idea of 'miasmas', disease entering the body through the skin when wet (Geels 2005) added to the rise of an era where bathing had indeed almost disappeared from daily life. But not forever, obviously.

1600 – 1950 a steady increase

For more than a hundred years, the public bath practically disappeared in Europe. When it emerged again it did so in a new guise: as therapy for a wide variety of ills. Somehow, the association of bathing with disease was transformed into a connection to health. Bushman and Bushman (1988) write that in the eighteenth century, words like 'invigorating' and 'vivifying' were used to describe the benefits of (cold) bathing. At this time, bathing was seen as a way to treat the inner body and baths were taken as tonic for the body (rather than for cleanliness) (Bushman and bushman 1988). At the end of the 18th century, bathhouses and indoor baths became more common, but regular bathing was still not routine. Even in the most elite households, only hands and face were washed daily. Illustrative is the example of a well-to-do Quaker, who first installed a shower box in his backyard in 1798. After taking a shower for the first time, a year after it was installed, his wife Elizabeth Drinker wrote in her diary that she 'bore it better than expected, not having been wet all over at once, for 28 years past' (Bushman and Bushman 1988).

Government intervention again played a part in the constitution of bathing practices, this time by stimulating frequent bathing (i.e. daily). For example, in 1846, the Public Baths and Wash-Houses Act was introduced in the UK. The act aimed to improve working-class sanitation standards and as a consequence, reduce disease and poverty. Repealing of the soap tax, which had been 100%, was part of measures taken. Next to these new laws, the public was educated on proper bathing habits through all kinds of manuals. An 1840 manual reads for example that 'cold or hot water in a bowl is all that is really necessary', recommending to 'just remove your clothing and apply the water to your whole body with your hands; and then rub the skin dry'. This could be done while standing on the floor, a carpet or in a shallow vessel 'like a large baking pan' (Bushman and Bushman 1988: 1226). Change did not happen instantly. Almost a century later, in the 1920s, the Cleanliness Institute in New York still saw a need to organize a 'Cleanliness Crusade' (Stuller 1991).

In the meantime, further advancements in medical knowledge contributed to making daily bathing regular practice for the bulk of the people. When, through scientific advances, the bodily system of 'skin' became more understood, the modern idea of bathing for cleanliness came to the surface. From the 1790s onwards, accounts on

perspiration and collection of dirt and grease on the skin became standard items in the bathing section in health manuals (Bushman and Bushman 1988).

Next to bathing as a civic duty, aspirations for climbing the social ladder were fuelling increased popularity of bathing as well. Bushman and Bushman explain that since visible signs of poor bodily hygiene, such as dirty hands, greasy clothes, offensive odours and grime on the skin became part of complex judgments about social position. To progress in life, cleanliness became one of the virtues to strive for. Added to the pressures to conform to cleanliness standards in order to be respectable and healthy, the force of advertising made the culture of cleanliness nearly irresistible. By 1859, water, hands and a towel alone were not sufficient anymore to get clean. Because of advances in knowledge on the chemistry of the skin, soap was now added as an essential to the list. An 1859 manual recommends a daily wash of face, hands and arms with soap as necessary to remove perspiration, oil, and dust.

When, at the start of the 20th century heating devices became more reliable and wide spread, warm water became more readily available and used for daily bathing (Stuller 1991). However, Stuller points out that even then, regular washing was still something that had to actively be learned; a 1908 public health manual called cleanliness 'an acquired taste'.

Post-war Europe

In post-war Europe, bathing became a real hit. While convincing arguments for engaging in it had been posed in the 19th century, being mainly health and social position, advancements in technical infrastructure after the two world wars enabled a sharp rise in the number of committed practitioners, and, in the resource intensity of the practice. In the Netherlands, the first central water supply system was built in 1853 in Amsterdam, and by 1970 all Dutch households were connected (OCW 2012). When in 1962, a large natural gas field was discovered on Dutch soil, the spread of water heaters took a leap. While in the 1950s the 'lampet' (see Figure 7-4) had been the main tool for daily washing of hands and face, around 1970 the separate bathroom with shower was gaining popularity (Figure 7-4). From then on, the shower started to overtake the bath as a popular way of full body

Figure 7-4 Lampetstel' and workman's home bathroom 1970
(Pictures: Nederlands Openluchtmuseum, Arnhem).

washing. Similarly, tracing back the practice of showering in the UK, Hand et al. (2005) find that showering has only become a serious alternative to the bath in the 1980s.

However, dirt remained problem of national concern and government still intervened in peoples bathing habits. Kira summarizes that a large study in 1970 reported that the average German at that time bathed 'only' once a week (10% even once every four weeks), and that in 1971 the British Safety Council felt compelled to distribute some 20 thousand posters to industries urging the workmen to 'wash, help stop skin disease'. Kira seeks an explanation for these 'stunningly low frequencies of bathing' amongst the 'lower classes' in the fact that unwashed skin and clothes might offer their wearers a 'very intimate personal security' (1976: 17-18).

Reflecting bathing practices of the time through his extensive research, Kira lists purposes of bathing as maintenance of health (importantly the prevention of 'vermin and various skin disorders'), maintenance of a certain level of visual and olfactory aesthetics and the use of water for sensual pleasure, of which the latter two are in the developed world the main reasons for bathing (1976: 25). Further on, he even mentions cleanliness as subordinate to the sensual pleasures when explaining showering as a daily affair. These observations, although made half a century ago, will turn out to resonate with observations made today. However, when Kira compares the bath and the shower, it becomes clear that bathing has changed in the past 40 years. While the bath is described as relaxing, soothing and feminine, the shower is in his words 'Spartan, distinctly masculine, business-like, and even uncontrollable, destructive and rough' (Kira 1967: 37). Especially the elderly, who associate the shower with public facilities and find it uncomfortable to stand, and women, who feel they 'cannot get as clean', prefer the bath as a way of washing. Today, as will become clear in the following sections, the bath and especially the shower have obtained quite different positions.

Overview of configurations over time

Table 7-1 gives an overview of the career of bathing from the Roman Empire to Kira in terms of images, skills and stuff.

The narrative and table illustrate how bathing has changed over time, sometimes even diametrically, for example, when bathing changed from a health hazard to a treatment of disease, or from a distasteful luxury to civic duty. These examples highlight that ideas of bathing as private pleasure are fairly recent developments, and that showering has only just overtaken the basin/jug and bath combination as a dominant way of washing the body. These observations strengthen the idea that bathing practices can change beyond reductions in shower durations.

On the other hand, this analysis also shows how some elements of bathing are deeply engrained. Obviously, water, but also soaps have long been core elements in bathing. And while connecting households to direct water and gas supply is a fairly recent development, it is not something that is easily undone. Moreover, knowledge of sebum, perspiration, bacteria, grease and other 'dirt' that resides on the skin, and need soap and hot water to be washed off is not easily erased from public knowledge. Although norms change, the norm of daily washing of at least part of the body has been around for centuries and clearly has a function for public health, and images of cleanliness, although clearly 'an acquired taste', have become part of what Bushman and Bushman (1988) call the 'innermost layers of the modern personality'.

	Images	Skills	Stuff
Roman Empire (500BC-500)	Bathing as focus of communal life, as basic social duty, later associated with fleshly excess	Daily around midday, sweat, linger, scrub, douse, scrape, plunge, converse	Public bath houses (balneum > thermea), steam, water, oils, sand, lentil flower, strigil, aqueducts
Middle ages (500-1500)	Bathing as luxury, materialistic, pagan and 'monstrous sensuality'	Wash hands before and after meal, wash teeth, face and hands daily in morning, sometimes Sunday family baths	Shallow basin and water jug, sometimes tub
Crusades (1000-1300)	Originally: enhance fertility, purification, retreat. Then: sexual enticement, plague	Sweat, socialise	Stews (public Hammam), heated rooms at different temperatures
1500s	Sexual temptation, bad for health, pagan, banned by church, forbidden by law	Stay away from water, don't get wet, skin as porous (miasmas)	Basin and jug, or nothing
1600s	Health retreat, cure for disease, tonic for the body, gentility	Be cured, plunge, refresh, soak	Public bath houses, tubs and shower baths, cold water
Late 1700s	Gentility and health, remove waste from skin	Wash hands and face daily with soap and water, occasional plunge bath	Perspiration, dirt, grease, skin, soap, basin and jug, towel, warm water
1800s	Health and cleanliness, prevent smell and enhance fair looks	Daily washing as common practice for higher classes, apply water to whole body with hands and rub skin dry while standing	Cold or hot water and a bowl, towel, soap, scum, dirt, skin
1850s	Cleanliness as a virtue, hygiene as a civil duty	Daily washing for larger masses, towel as a cleaning tool, knowledge about contagion	Soap (untaxed), hot or cold water, dirt, towel, bacteria and viruses?
1900s	Cleanliness as acquired taste	Judging cleanliness from looks and smells, being appropriately clean in public	Plumbing, soap, hot or cold water
1950s	Bathing for cleanliness and hygiene	Daily washing of hands and face and weekly family bath	Plumbing, lampet, family bath tub
1970s	Bathing for sensual pleasure, bathing as private affair	Taking a bath or showering several times a week, full body washing	Dedicated bathrooms, showers, natural gas supply, hot water and (liquid) soap

Table 7-1 Overview of different constellations of elements in the historic career of bathing.

7.2.3 Exploring similar practices: bathing in Japan and India

In a search for desirable bathing practices, Japan and India came forward as countries of specific interest. Japan because of its similar level of living standard and strongly different ways of bathing and India because of its strongly lower level of resource consumption required for bathing. Data on these practices was collected through literature study and the consultation of (tourist-oriented) blogs and other publications. In addition, to get further insight in the particular relation between the practices and their levels of resource consumption, a workbook and interview study was conducted (Matsuhashi et al. 2009).

Japan
The Japanese Inn Group (in Clark 1994) explains the differences between a Japanese bath and baths in 'other countries' as follows:

- You take a hot bath not only to wash yourselves but to relax comfortably in the hot water.
- You do not wash yourself in the bathtub, but wash and soap outside the tub.
- The hot water in the tub is used by more than one person.

In addition, they describe the rough procedure as: undress outside of the bathroom, wash the body, enter the bath and soak, finish but do not drain the bath. Some similar and additional instructions can be found in Figure 7-5.
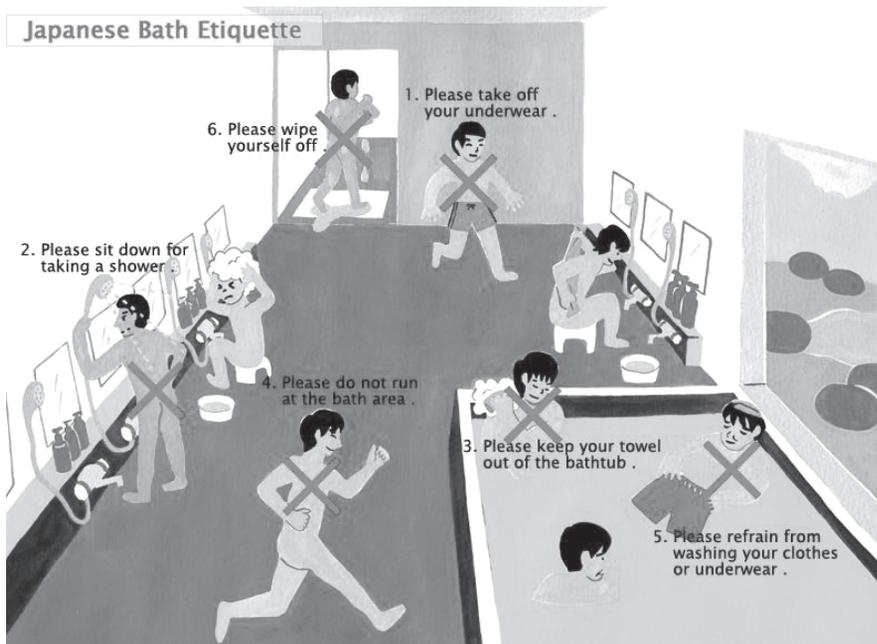

Figure 7-5 Instructions on how to bath in Japan (Image: travel-japan.jp).

Anthropologist Clark (1994), in his book 'Japan: A view from the bath', elaborates that soaping can come either before or after soaking in the tub (if done at all), but the body is always washed in some way before entering the hot water of around 41-43 degrees Celsius. The Japanese bathe daily, in the evening, either before or after dinner, taking approximately 30 minutes. Young children usually bathe with one of the parents. In Japan, bathing is an integral part of social life, family members bathe together or use the same water and it is common for friends and colleagues to socialize in hot spring resorts. Figure 7-6 shows an impression of the material composition of Japanese bathrooms.

Figure 7-6 Bathrooms in Japan (Matsuhashi 2009).

India

Blogger Chris Chopp explains that in India the common way of bathing is a bucket bath, entailing a bucket containing around 19 litres of water and a mug to pour the water over your body (see Figure 7-7). When taking a bath, the first step is filling the bucket, either from a tap or by boiling water in pots and to check the temperature. He continues:

> 'Begin by pouring one or more mugs of water over your body from the head down until the entire body is wet. Then apply shampoo and rinse, making sure the soapy water does not enter the bucket but ends up on the floor. Then, dip a washcloth in the bucket when needed and soap the body, again making sure no soap enters the bucket. Scrubbing hard helps to warm up the body. Use the mug to rinse the body and repeat as needed. After finishing, any remaining water in the bucket can be kept to use for example for laundry and the floor wiped with a squeegee.' (Chopp 2012)

An Indian commentary to the entry praises the representativeness of the account, but emphasizes that in order to keep the water in the bucket clean, it is common to take a step back from it when washing.

Figure 7-7 Bathrooms in India (Matsuhashi 2009).

Comparing bathing styles

Detailed data from a workbook and interview study that compared ways of bathing and their resource consumption in Japan, India and The Netherlands conducted by master student Noriko Matsuhashi, led to a classification of bathing routines into three major styles: showering, taking a bath and washing from a reservoir, each with different resource requirements as depicted in Figure 7-8.

100 liters   200 liters   20 liters
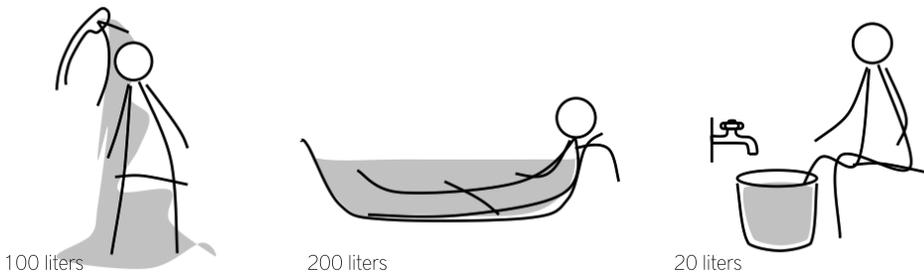
Figure 7-8 Three bathing styles and their average water requirements (Matsuhashi et al. 2009).

These styles were in the case of Japan combined into a mixed style, while just 'showering' was reported only by the Dutch participants and 'washing from a reservoir' alone, only by the Indian participants.

Results of the study included the insight that, while this is the case with showering, total water consumption for bathing is not always proportional to its duration. While analysing the data, a way of classifying actions emerged. They were: 1) actions with running water, 2) action with bathtub water, 3) actions with water in a reservoir and 4) actions without water. The analysis also pointed out relations between contextual elements. For example, a clear relation between postures and the use of tools was detected. Most of the actions using water from a reservoir were done when participants were sitting on a stool. Also, the action 'leaving the water running for adjusting water temperature' was reported by all participants, but only Indian participants achieved the action without using extra water, since they used a reservoir while adjusting the water temperature (Matsuhashi 2009).

7.2.4   Mapping the target practice: showering in the Netherlands today

Showering is the dominant bathing practice in the Netherlands today. Analysis of the target practice aims to make a connection between the configuration of the practice and its related resource consumption. This was done by dissecting water consumption for showering into four variables, being shower frequencies, shower duration, water flow level and water temperature.

Shower frequencies

Although numbers show that showering in the Netherlands is not something necessarily daily; 58% of the Dutch who shower, do so less than 7 times per week (Foekema and Van Thiel 2011), it does have a strong image of being a daily affair. Body washing is advised by experts as a daily activity for social appearance, and to exercise 'proper skin care' (Everdingen et al. 2011) and has been promoted as such by government and health institutions for centuries.

In the qualitative studies conducted for this thesis (involving interviews and workbook surveys), the great majority of participants reported showering daily or more. Figure 7-9 contains an overview of the reasons participants gave for bathing. A possible additional reason for this particular frequency emerging from these studies was the connection between showering and *daily* routines, such as getting up in the morning or going to bed in the evening. In the group session that was part of the field studies, emotions ran high on this topic. According to the participants, a morning shower is really needed and when missed, they agree that you somehow feel dirty for the rest of the day. A situation of not
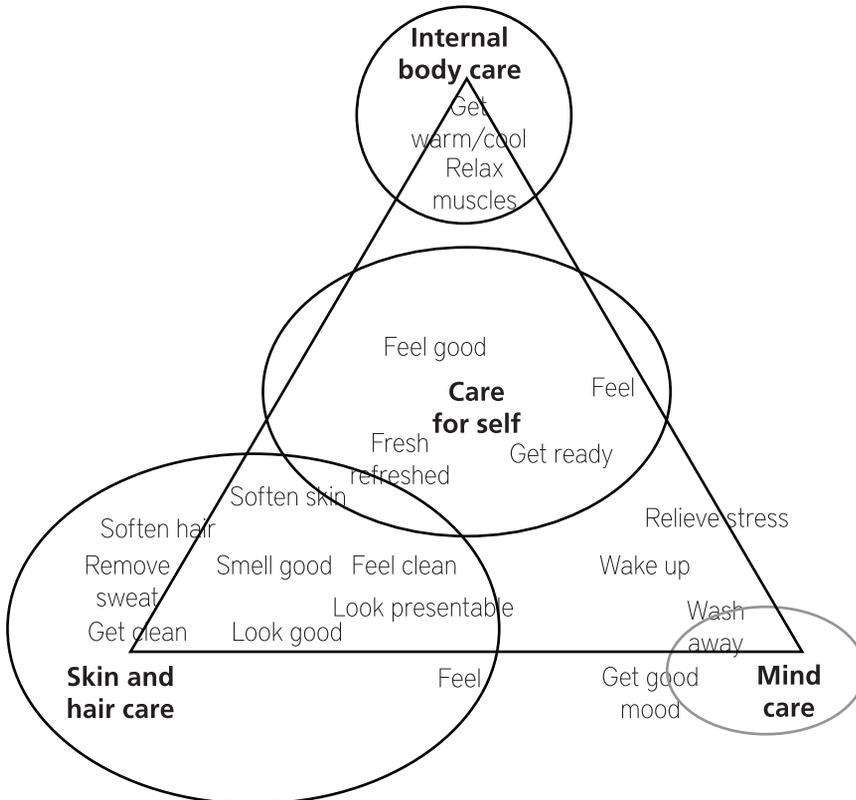

Figure 7-9 Grouping of image aspects of bathing as a practice as mentioned by the participants in the experiments in practice study (size of circles corresponds with frequency of aspects mentioned) (Kuijer and de Jong 2010).

being able to shower, for example in case of refurbishment, was referred to as 'horrible'. This image of showering as something that should be done daily, while not necessarily done daily, was also reflected in a number of 'confessions' made to the author informally where people revealed that they showered less than daily, often with an air of secrecy. A common reason for these people to shower less than daily is skin problems; they feel the shower dries out their skin.

An overview of reasons why participants indicated they did shower, regardless of the frequency is given in Figure 7-9.

Although reasons for showering are various, the care for skin and hair is the form of care that is most closely connected to the core actions and products in bathing - applying warm water and soap to skin and hair. Additionally, judging from the number of alternative ways of achieving these goals that participants could come up with, also most difficult to replace with actions and products outside the practice of bathing.

Analysis of the stuff of bathing revealed how the convention of daily showering is embedded in and thus confirmed and strengthened by use instructions accompanying soaps and shampoos. For example, instructions like 'PS: don't just apply once in a while, because in skin care every day counts', 'Use [brand] products daily to keep your skin healthy', 'In case of daily use it helps to build the fairness of your skin from within for a more beautiful skin. For the best result, use daily', and a shampoo called 'Every Day'.

Shower durations

Different from other forms of bathing, the duration of a shower directly correlates with the amount of warm water that is used. The time it takes to complete a shower depends on what is done in the shower and for how long. The basic shower cycle is to turn on the shower and get wet, followed by some basic actions related to taking care of hair and skin and to rinse off any soaps, shampoos or conditioners when applicable. Many variations on this basic cycle are possible. Short showers may leave out any soap or shampoo and just be about rinsing the body, while possibly even keeping the hair dry. When specified in terms of minutes, short generally means 5 minutes, as for example reflected in the shower timers distributed by environmental organisations (Figure 7-10), but in the study by Foekema and Van Thiel (2011), shower times of 1 minute have been reported. On the other end of the spectrum, shower durations of almost 1 hour were also registered.

The use of soaps and shampoos adds to the time it takes to complete the shower. While dermatology experts advise moderate use of soaps, some participants indicated to use soap and shampoo twice per shower. Especially for conditioner, but also for shampoos, the idea of it needing some time to be 'absorbed' or

Figure 7-10   Five Minute Shower Timer (Image:Total Merchandise Ltd).

'soaked in' exists (some shampoos advice soaking of several minutes). This idea of soaking clashes with the paradigm of constantly flowing water. In the studies, some participants indicated that they turn the shower off during the application of soap and/or shampoo. This shortens the duration of water flow, but can result in a 'rebound effect' of showering longer to get warm again.

> 'applying shower gel (getting cold while doing so because water is switched off here), then rinsing and getting warm. This part easily gets extended until I feel time pressure. I need to get warm enough to survive the time until I'm dressed' (Experiments in Practice, Participant 3)

The idea of soaking does not seem to be so common for soap, but soaps are advertised as nutrient for the skin (while their cleaning capacity is hardly mentioned as an asset). In line with the idea of soap as nutrient is the development of 'sticky' shower gel that now needs abundant flowing water to rinse. This is contradictory with expert advice warning that not rinsing off soap is bad for one's skin. While 'skin' is by some participants subdivided into different types of skin, for example facial skin requiring different treatment than skin on the arms of belly, others wash both skin and hair in one go with the same type of soap or shampoo (whichever is grabbed first). Next to washing skin and hair, a range of other body care actions were mentioned, such as shaving, scrubbing, brushing teeth, removing callous skin, and facial and hair masks. Next to these body care actions, just standing under the warm water passively, to get warm, to relax, to come up with great ideas, to think over the day or to just dream away greatly adds to shower durations. One of the skills of showering is to be able to stop it, to snap out of the dreaming and mesmerizing, to be in time for work, or to let other household members in.

The kind of shower people took (i.e. which actions are combined in which way), from quick functional, including only the basic cycle, to pamper showers, including most of the actions mentioned above, depended on the situation. A returning theme was the tension between a tendency to dream and mediate in the shower and the urge to get out, because of further obligations or because of a feeling of guilt about wasting water, fuelled by water saving campaigns. Along these same lines, shower durations are a well-known point of conflict between parents and teenage children. While younger children may need the necessary persuasion to bathe often enough, parents almost unanimously complained about the long shower durations of their teenage children.

Shower flow

Latest trends in the bathroom industry emphasize a link between abundant water flow and images of joy, relaxation, pleasure and energizing (notably, getting clean is not part of these) (Figure 7-11). At the same time, water saving efforts of the bathroom market primarily focus on restricting flow. When restricting flow, however, explanations are quick to emphasize that none of the 'abundant water' experience is lost. An instruction manual on such a product reads for example 'the EcoSmart function reduces water consumption by 50% and guarantees the intensity of the shower spray'.

According to Foekema and Van Thiel (2011), the comfort shower or rain shower, with a flow of over 14 litres per minute, has so far not widely spread (only 4% of their

participants reported to own one), while the water saving showerhead (7,4 litres per minute) has steadily risen since the 1990s to a penetration rate of 50%. However, this small, but growing percentage of 'high flow' showers already showed an effect on the average water consumption levels measured in the study and bathroom companies even advertise showers that have a flow of 50 litres per minute. However, 50 litres per minute does not seem to be a feasible, near-future possibility, since the flow of a shower is restricted by capacities of water infrastructures, which vary, but are around 12 litres per minute in the Netherlands.

Figure 7-11 Abundant water flow as an ideal shower experience (Image: Flickr.com).

Shower temperatures

Experts advise water temperatures for showering of 37-38°C, a value reflected in modern thermostatic valves. In households with comfort showers, however interviewees indicated that when using the large top shower, called rain shower, they tended to turn up the temperature compared to the hand shower because 'the drops are bigger so it is less warm" (Daniel) and the shower is positioned higher (Sandra). This may indicate that with a trend towards comfort showers, shower temperatures may also increase. Another observation regarding temperature is that people tend to increase the temperature of their shower during showering.

Connecting consumption and elements of showering

Table 7-2 contains an overview of the different variables of water and energy consumption for showering, their ranges of variety, averages and trends, and relates them to the routines and rationales of showering found in the qualitative studies.

Strong links and core elements in the target practice:

- The idea of body washing as a daily necessity is, at least in common discourse, strongly engrained in practitioners
- There is a strong link between showering and feeling clean
- There is a strong link between proper, acceptable body care (which comes down to getting clean), the use of warm water and soap and existing infrastructures;
- Bathrooms are fixed entities of the house that have a long life span

Threats and trends regarding resource consumption:

- Showering frequencies show a trend of increase; up from 3-4 times to 5-6 times per week between 1992 and 2010 (Foekema and Van Thiel 2011), and although not yet daily for most people, several elements of the practice indicate that this is where it is likely to move towards
- The development of higher flow shower products in combination with a link between abundant water flow and luxury

- The spread of comfort showers seems to require increased shower temperatures

Tensions in the target practice:

- Between actual showering frequencies and common discourse on proper shower frequencies
- Between enjoying to stand under the shower and ideas of proper shower durations in relation to health, other obligations and ideas about qater conservation
- Between the constantly flowing water of the shower that rinses away dirt (and soaps) and the idea of soaking and absorbing of soaps and shampoos for proper body care
- Between the pleasures of hot water (and soap) on the body and problems of dry skin
- Between future images of high flow showers and the capacities of water infrastructures
- As also found by Hielscher and Scott, in the use of soaps, there are tensions between good and bad grease and natural and chemical ideas of body care

	Variety (av/ standard)	Trend	Relation to practice
Frequency	1-14 times/wk (5,5 times)	Increasing	Discursive norm is daily, deemed necessary daily for proper body care, relation to other (daily) practices, soap and shampoo use instructions.
Duration	1 - 55 min (8 min)	Relatively stable	Actions performed in the shower, including 'soaking' of soaps and shampoos and 'just standing', activities after the shower (need to get out), ideas of normal shower durations, incl. idea of 5 minutes as a short shower.
Flow	7,4-50 litres/min (7,7 litres/min)	Increasing	Learned feeling of comfortable flow level, link between abundant flow and luxury, shower head design, tap design, capacities of water infrastructures.
Temperature	± 38°C (38°C)	Increasing	Shower tap design, physiology, routines and expectations of comfort, heater capacity, link between hot showers and dry skin, height of shower head.

Table 7-2 Connecting consumption variables and practices.

7.2.5   Identifying opportunities for change: from flowing to contained water

The target set at the start of this design project is to reduce water consumption for bathing from an average of 340 to an average of 105 litres per person per week; a reduction of 70%. Because in bathing, water use means warm water use, this is expected to also mean a reduction of 70% of the energy used to heat the water. When looking at varieties in water consumption, both Dutch history and bathing practices in other countries show that this target could be achieved. How, was further investigated by going into detail on bathing in Dutch history and in other cultures.

It becomes clear that just 50 years ago, average water consumption for bathing in the Netherlands was around the target level. The daily basin/jug + weekly (shared) bath combination required considerably less water than showering today (estimation is between 50 and 100 litres per person per week). In the 1970s, the shower quickly gained ground. Especially compared to the flannel wash, the shower is far more resource intensive. This difference can be attributed to the paradigm of constantly flowing water, where the water touches the body for a few seconds and disappears down the drain, still fairly warm and clean. At the same time, the paradigm of constantly flowing water in the shower creates a number of tension fields: feelings of guilt or conflict when enjoying it for 'too long', soaps rinsed away directly not being able to soak or be absorbed, and 'good grease' being removed together with 'dirt'. Looking back at the time of the introduction of the shower, these tensions were even more clear, when showering was described as 'uncontrollable, destructive and rough', difficult to get clean and uncomfortable to stand. Although people have learned to appreciate it, showering can possibly be unlearned again using the tensions identified in the study. Combining these insights with studies into bathing in other cultures, where for example in India washing from a reservoir requires less than 20 litres (Matsuhashi et al. 2009), it can be concluded that (close to) daily showering (with its constant flow of warm water) is certainly not the only, arguably not the most effective and clearly not the least resource intensive way of bathing. The opportunity selected for further exploration is 'a way of bathing that is based on washing with contained rather than flowing water'.

7.3   Reconfiguring practices of bathing

Making a shift from flowing to contained water is not just a matter of replacing the shower fixture with a bucket and a scoop. In order to make bathing from a reservoir work in the Dutch setting, bathing practices would need to be reconfigured in a more encompassing way. Introducing a reservoir is just one step in this process. As proposed in Chapter 6, the practice-oriented reconfiguration process involves iterative cycles of suggesting and triggering reconfigurations, facilitating performances and combining and refining proto-practices. Below, in Figure 7-12, the model discussed in Chapter 6 is included for reference.
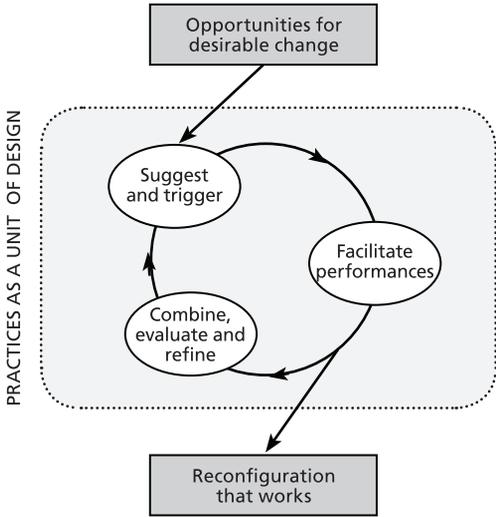
Figure 7-12 From opportunities for intervention to reconfigurations that work; practices as a unit of design.
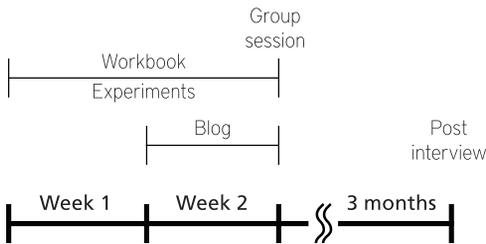

Figure 7-13 Set-up of experiments in practice study (Kuijer and de Jong 2010).

This section describes four cycles following this process that were made in the bathing projects, these being: experiments in practice, try-it-out experiments, generative improv performances and prototype field studies. The set-up and results of each iteration are described below.

7.3.1. Experiments in practice

'Experiments in practice' is an approach developed by Kakee Scott (2008). A first version of it was executed by Scott in August 2008, within the context of the FP7 Living Lab project. A second study, conducted within the same context, was led by the author and executed in November 2008. The set-up of both studies was very similar, except that where the first version focused on the study set-up itself as an incubator for change, the second study had a stronger focus on generating insights for product development.

Suggest and trigger

Focal assignment for participants in the experiments in practice study was to come up with and try out different ways of bathing that are lower in resource intensity than showering. There was in this case no explicit suggestion of a proto-practice, only a case of triggering experimentation. A workbook guided participants into first unravelling their bathing routine into the elements of images, skills and stuff and to take a step back by mapping how their bathing styles had changed during their life-time. It also included the assignment of interviewing someone from a previous generation about bathing practices in their youth. After coming up with an experiment, participants were asked to perform these different forms of bathing in the setting of their own homes for a period of two weeks. During the study, participants interacted with each other on a blog. After the two weeks, part of the participants came together for a joint reflection and design session and three months after the study they were interviewed about possible lasting effects of their participation. An overview of this set-up is offered in Figure 7-13.

Sixteen people from a variety of European countries, all somehow related to the Living Lab project, participated in the study.

The performances

The idea of making a shift from flowing to contained water was not part of the experiments in bathing study, but some of the participants did come up with this option themselves. Table 7-3 offers an overview of types of experiments engaged in by participants.

Strategy	Tactics (additional things used)
Reduce shower duration [7]	• Collect 'set temp.' water for flushing toilet (bucket) • Turn off shower when soaping • Think more consciously about shower time (stopwatch) • Eliminate 'useless' minutes in shower • Change shower time from evening to morning • Get comfort by going back to bed • Change order of product use • Eliminate cosmetics like conditioner, scrub or shampoo
Reduce shower frequency [4]	• Replace part of showers with washing at the sink (sink, washcloth) • <u>Replace all showers with washing from bucket while squatting (bucket, cup, washcloth)</u>
Reduce use of cosmetics [6]	• Use less soap/shampoo per time ('puff') • Reduce frequency of use • Eliminate conditioner • Replace with environmentally friendly products (biological soap, ghassoul*) *an Arabic form of soap consisting of a particular form of soil
Reduce gas [2]	• Turn temperature shower down
Reduce electricity [1]	• Shower in the dark

Table 7-3 Overview of types of experiments in experiments in bathing study.

In the light of the opportunity identified in the analysis phase, specific interest goes to those experiments involving washing from a bucket, which are highlighted in the table. In these experiments, the bucket wash concept was used as a replacement for all showers. The amount of water used by these two participants differed. One participant mentioned to use 5 to 6 buckets of 12 litres per wash to wash and rinse her hair and body, adding up to approximately 70 litres per day (Figure 7-14 contains a detailed description of one of these experiments from a workbook). The other participant that engaged in the bucket bath experiments mentioned that one bucket of 10 litres was enough to wash her body and hair, or that when hair was not washed, 5 litres was more than enough to wash the body. When washing hair every other day, as was usual among this group of participants, water requirements per week would add up to 55 litres.

Reflecting on their experiences with washing from a bucket, the two participants reported discomfort, mainly because they felt cold. However, they also experienced their 'bucket wash' routine as rewarding, effective and relaxing. Although they felt
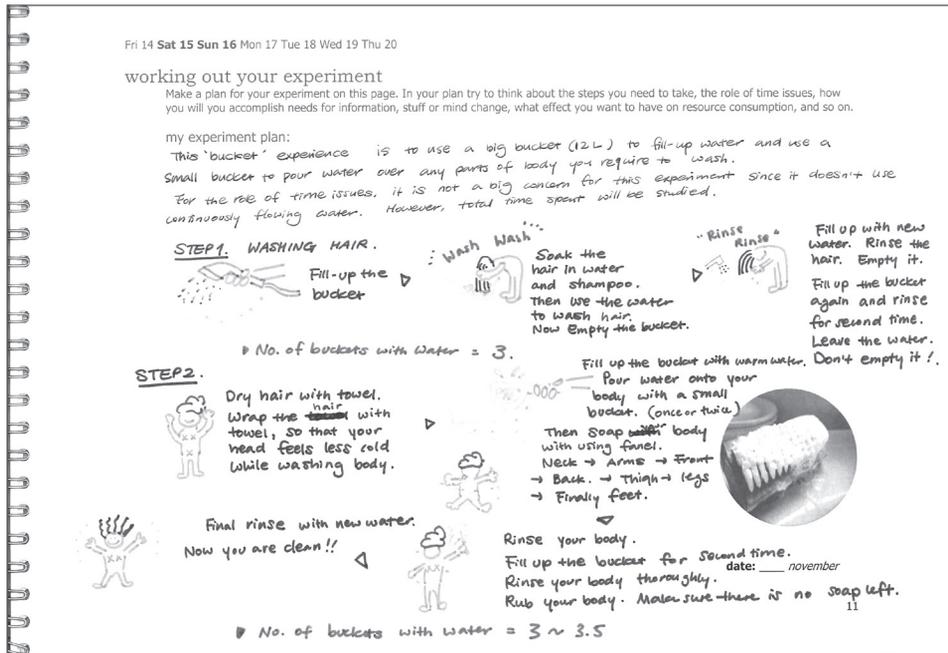
Figure 7-14 Description of bucket wash experiment by one of the participants in her workbook.

cold and a little uncomfortable squatting and bending down to reach the water, they were in general positive about the experience. One of them continued washing from a bucket for a while after the study, mainly because she enjoyed it (it was quicker, something new and it felt good saving so much water). Finally, she quit because she moved to a place with a bathroom that was colder than the previous one, but was thinking about starting again in spring when temperatures go up. The other participant was still using a bucket in her bathing routine three months after the study. She now took regular showers again, but continued to wash her hair using the bucket. She realized that it was much easier to handle her hair when it was hanging in the bucket. She stopped washing her body from a bucket because it was too cold. Also, now that it is in her shower, she uses the bucket to collect the cold water that comes out of the pipes when the shower is warming up to flush the toilet.

Combining, evaluating and refining

From this early exploration, it can be concluded that washing from a bucket requires considerable reconfiguration of bathing practices. A bucket is added, a squatting position is adopted, and other things like cups, wet towels and sponges are recruited into the performance. New skills are required as well, like separation of washing hair and body. However, the study provided little insight into shifts in meanings of bathing that may or may not be accompanied by a shift towards washing from a reservoir. Also not entirely clear is whether the bucket wash is less resource intensive than showering, because one of the participants used 70 litres, which is more than an average Dutch shower today. The

other participant however, showed that it is possible to use considerably less water than for showering. The observation that both participants who tried it were willing to continue their experiment shows that they nearly made it work. Both mentioned a feeling of being cold as their reason to abandon it eventually. These insights and questions were taken further into the next iteration.

7.3.2   Try-it-out experiments

The try-it-out experiments study was developed and conducted in the setting of the graduation project (supervised by the author) of Harish Karakat as part of the Integrated Product Design master program at Delft University of Technology. The assignment was to take insights gathered in earlier bathing projects and to 'translate these into innovative bathroom designs'. The assignment contained the specific requirement to check ideas with 'users' from an early stage. It was executed in cooperation with the Dutch bathroom company Sealskin. This project resulted in two main concepts: splash and scrub. Splash was worked out into a detailed design and a foam model.

Suggest and trigger
As opposed to the experiments in practice study, participants in the try-it-out study were not entirely free to come up with their own experiments. Instead, they were asked to choose from two suggested ways of bathing. Using elements readily available in the domestic setting, participants had to pick an experiment – to bathe from a bucket or to perform a sponge bath – and to perform it at least twice. Figure 7-15 contains an example of a task description.

P2: Bucket bath

    The bucket bath is a hybrid concept of a shower and a bath. The idea is to use water from a bucket to take a wash.

    Products used: bucket, mug, soap/shampoo etc.

    Process outline
    Collect (warm) water in a bucket (around 20litres).

    You may use a mug to take the water out of the bucket and pour onto your body.

    The manner in which you use soap and rinse is all left up to you.

    You may sit on a stool or stand or squat etc.

    Keep a note of the water you used. Usually if you used only one bucket – the volume of the bucket is an indication of the water used.

Figure 7-15 Presentation of a proto-practice in the try-it-out experiments study (Karakat 2009).

The performances

Because of time constraints, the study involved only five participants, of which three choose the sponge bath option and two the bucket bath. To document their performances, they were asked to report on their experiences in a workbook, which was used as the basis for an interview. The focus in the documentation was on obtaining detailed knowledge about the process of actions of performing a sponge or bucket bath.

Combining, evaluting and refining

The performances were summarized in a brief description and several process maps (such as in Figure 7-16) describing both similarities between performances and varieties.

BUCKET BATH STORY BOARD – 1   12,5 min   20,5 L

collect warm water   undress   shampoo hair   wash hair

apply soap on sponge   scrub/rinse   wash napkin   final wash

Figure 16.   Process map of Bucket bath derived from descriptions of 'Try it out' participants

43
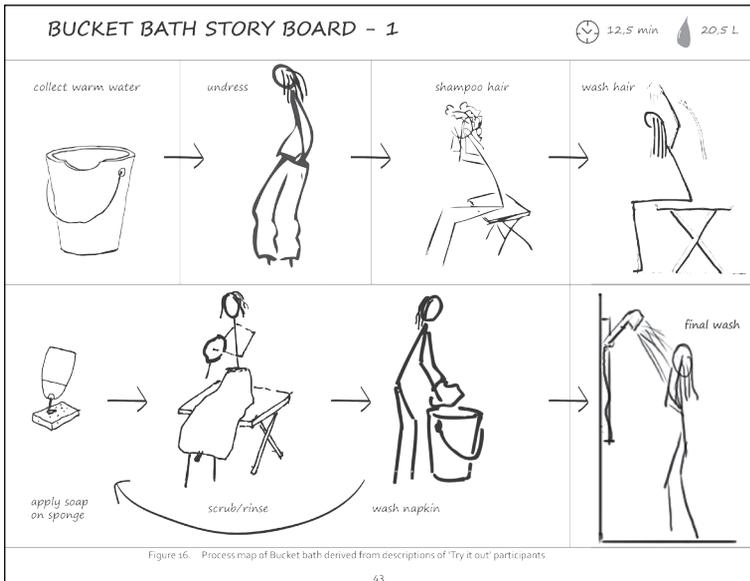
Figure 7-16 Process map of bucket bath derived from descriptions of performances by participants (Karakat 2009: 43).

Different from the performances in the experiments in practice study, these participants used a small stool to sit on (instead of squatting down), and as a strategy to get warm again and rinse soap, they briefly used a shower after their bucket bath. Reported amounts of water use were 30 and 11 litres respectively. Both participants explicitly mentioned to use and enjoy a flannel or sponge to apply water and soap to their bodies. Also enjoyed was the feeling of splashing water over the body as opposed to having a constant flow, an observation that led to the name of the concept.

Both the sponge bath and the bucket bath concept were worked out by the student into more refined designs in which there was a focus on the objects used. In both concepts, the student included instructions for a procedure of washing, including postures and movements and new (to bathing) vocabulary such as the terms splash and splashing,

scoop, seat, wash bowl, scooping and pouring (Figure 7-17). The sponge bath concept will not be further discussed here, because it was not developed further, but it can be found in Karakat (2009).

Emphasized in the design proposal of the student is the necessity of the *removal* of the existing shower from the bathroom. This is important, because 'to introduce a new culture, it was felt necessary to kill the old culture by replacing the showerhead in a bathroom' (Karakat 2009). In addition to a digital design, the student also made a real size foam model (Figure 7-18). This physical prototype formed an important part of the practice-prototype for the next cycle of performances.
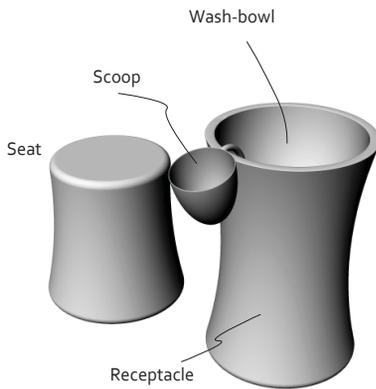
Figure 7-17 Version one of the Splash concept (Karakat 2009).
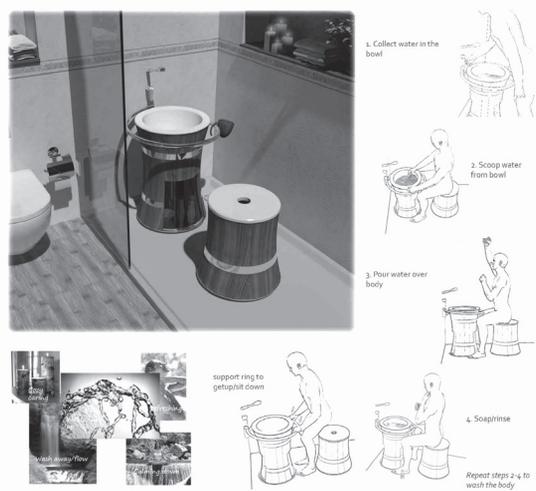
Figure 7-18 Foam prototype of the first splash design.

7.3.3 Generative improv performances

In this iteration, the generative improv performances (GIP) method was developed and piloted by the author. The goal of the study was to further flesh out the concept of splashing in terms of configurations of images, skills and stuff. This section is largely based on Kuijer et al. (2013).

Suggest and trigger

The set-up of the GIP study involved a lab setting of a simulated bathroom with the splash foam model in which improvisation actors were asked to perform a fictive scene of their splashing 'routine' in detail, followed by an interview. In the lab, a bathroom-like space of approximately nine square meters in size was equipped with different props like a bath carpet, a bathrobe, soaps, plastic ducks, towels and sponges (Figure 7-19). Instead of the familiar bathing fixtures (bath, sink, shower), it contained the splash foam model, consisting of a basin (with a content of approximately 20 litres) on an integrated stand, and a seat. The model was deliberately left open; there were for example no buttons, taps or drains on it and was made of foam with uneven plaster and cardboard parts attached with sellotape (Figure 7-19).

Figure 7-19 A selection of props available in the simulated bathroom and the rough prototype (Kuijer et al. 2013).

A foam model in a lab environment however, was not suitable to be used with water. Therefore the choice was made to, in this stage of development, have a dry bathroom with only imaginary water. This allowed participants to take part wearing their normal clothes, something that greatly helped recruitment.

The fictive scene the participants were asked to perform was roughly sketched out by a number of instructions, the format of which was based on the type of instructions used in improvisation theatre. In summary they were:

- imagine this is your own bathroom and that splashing is your normal way of bathing with which you are satisfied,
- perform a complete splash session starting by entering the bathroom, at least washing your body and hair and leaving the bathroom after finishing,
- pretend to be bathing and make a credible performance with eye for detail, paying special attention to the water, you can imagine the space to be comfortably warm,
- you can use all objects you see around you and if you want to use something that is not there, imagine it; the only thing you cannot use is a shower hose or shower head with continuously flowing water.

Because of their specific skills, the involvement of improvisation actors was sought, with the expectation that they are:

- trained to improvise and thus make situations work by coming up with creative ways of doing.
- used to working at and over the borders of what is considered normal and appropriate, because "actors free themselves from socially accepted frames of reference and assumptions of expected behaviour" (Vera and Crossan 2004)
- used to imagining things that are not there, such as for example water.

Moreover, for this study specifically it is useful to work with people who are not hesitant to perform a private activity, like bathing in detail while being observed. Participants were all experienced practitioners of showering.

The performances
Seventeen participants took part, nine of which were trained improvisation actors. Together, they produced 25 performances of splashing; most participants performed twice, either in a duo performance as requested by the researcher, or in a second individual performance on their own initiative.

For capturing the performances, four cameras and a microphone were installed in the simulated bathroom space. The images were both recorded and broadcasted live for the researcher. After the performance, interviews were held with the participants while still in their role. It focused on eliciting the explanations that are used to position splashing as an acceptable form of bathing.

Combining, evaluating and refining
The 25 performances were analysed in detail and summarized in graphical overviews using a pictogram library, which itself emerged from analysis of the performances (see Figure 7-20 and Figure 7-21).
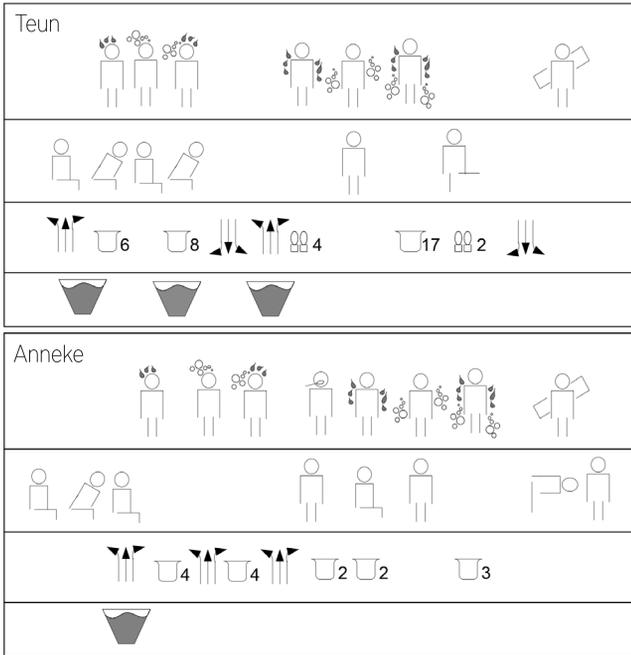
Figure 7-20 Graphical overviews of the performances of Teun (top) and Anneke (Kuijer et al. 2013).
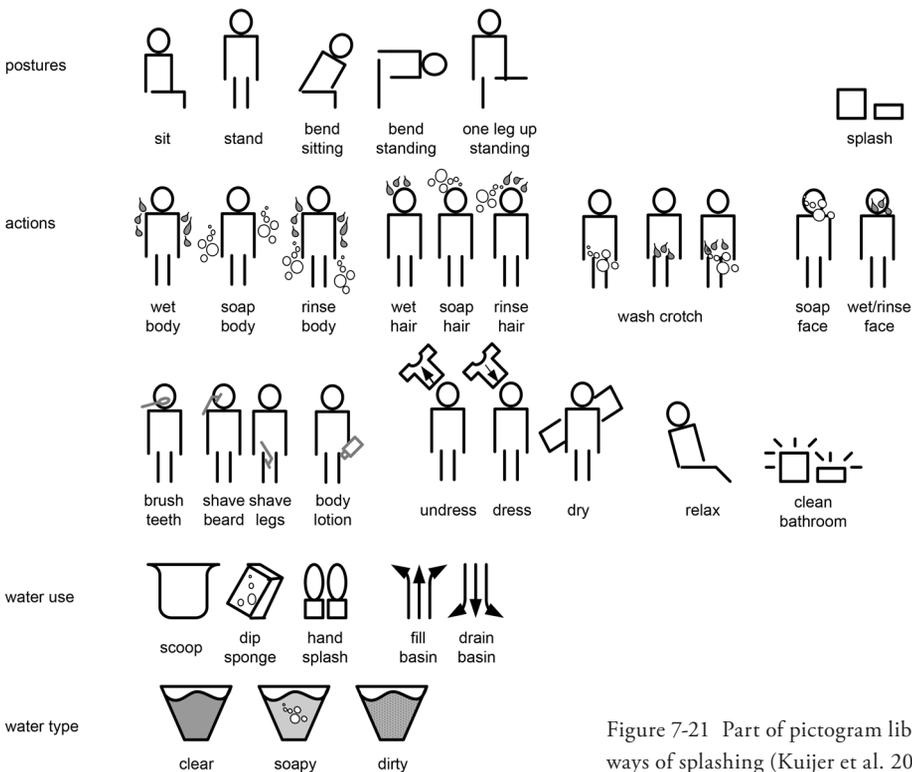
Figure 7-21 Part of pictogram library of ways of splashing (Kuijer et al. 2013).

An overview of different aspects of variety that resulted from analysis of the set of performances is offered in Table 7-4. The table is not exhaustive, but rather gives an impression of the types and range of variety found in the study. Dimensions of variety occurred in all elements of the practice and in the relations between them. For example, 'ways of wetting' mainly involve skills, 'interactions' zooms in on the stuff in relation to skills, 'likes' and 'dislikes' surface aspects related to image, and 'durations' and 'water use' give estimations of resource consumption.

Washing sequences	Head to feet, feet to head, from torso outwards, only upper body, start with hair, end with hair, intermediate dressing and drying, dressing and drying at end, soap hair rinse hair then start with body, soap hair soap body then rinse body and hair
Ways of wetting	Scoop and pour or splash with cup or bowl, soak and squeeze sponge or wash cloth, splash with hands, immerse body parts in basin (arm, foot, head)
Ways of soaping	Make soapy water in basin and rub with sponge (with or without separate wetting first), put soap on hand and rub on body, put soap on sponge and rub on body
Ways of rinsing	Scoop and pour, rub with washcloth then rinse and wring out, splash and rub with hands, with towel together with drying, immerse hand or foot in basin and splash with hands
Actions besides washing	Shaving, drinking, brushing teeth, listening to music, applying body lotion and make-up, playing, relaxing
Postures	Sit on seat, stand in front of basin, put foot on seat, put foot in basin, sit on basin, bend over basin, lean on basin
Durations	From 2 minutes to 19 minutes
Water use	From approximately 4 litres of actual water for washing to over a 100 litres (several refills basin, flooded floor, tap and drain open continuously, water jets from basin and walls)
Interactions	Place things like sponges, soap bottle, washcloth, razor in or on edge basin and seat, have tap above basin, on edge basin, integrated in sides or bottom basin, on wall, on seat, with digital display, with turn knobs, with foot pedal, by rubbing side basin, have mirror above basin
Likes	Saves water, it's quick, you can take your time, it's relaxing, it is comfortable, it is deliberate, enjoy the feeling, it stimulates the senses, it is flexible, it is cosy, it is fun, it is compact, it creates little moist
Dislikes	Do not feel satisfactorily clean, makes a water mess, it is slow, it is not relaxing, it is boring, awkward to sit naked, miss the flowing water

Table 7-4 Overview of variety in performances (Kuijer et al. 2013).

From this variety of performances, a preview of the reconfiguration (as an entity) emerges. Results of the study indicate that splashing could be an active, flexible way of washing the body with water from a basin, involving sitting and standing postures, a range of ways of applying water and soap, involving scoops, sponges and hands, in varying sequences. Rather than rinsing with constantly flowing water, soap plays a central role in cleaning the body. Splashing can be quick and functional, washing selective parts of the body, but also a relaxing, time taking ritual with a focus on scent and deliberate body care. When looking at the (virtual) amounts of water participants required for splashing, there are indications that it can be considerably lower than that required for showering. An important reason for this potential lies in the decoupling of water use from bathing duration. This point is illustrated in Table 7-5. It has to be mentioned that these amounts are estimations made on the basis of performances that did not include actual water, nor the experience of wet nakedness and vulnerability to cold that come with it. The exact numbers therefore mean less than their order of magnitude in relation to the bathing strategies they entailed.

	Time (minutes)	Warm water used for splashing (litres)	Water required for shower of same duration (litres)
Anneke	10	4,5	74
Maartje	19	50	141
Marcel	4,5	4	30
Magnus	2	10	15

Table 7-5 Some examples of the time taken for splashing and the amount of water used.

Besides insights into potential effects on water and energy consumption, the performances generated recommendations for further refinement of the splash concept. Further refinement is focused on making the reconfiguration work. This means a focus on dislikes or reasons why it currently does not work. However, it does not mean that all these dislikes should somehow be 'solved'. That some participants found splashing slow, not relaxing or boring, where others find it quick, relaxing or fun does not mean that splashing is these things. Rather, this shows that all these different links were made through the performances and thus that their potential is there in the current design. Further development means channelling the development of these links in beneficial directions. For example, the deliberate way of washing the body that is part of splashing was considered as a challenge ('in splashing you have to rather explicitly think about all parts of your body') or quality ('if you take the time to really scrub, well, on each limb then yes, nice, just peacefully start up, yes, that is a great advantage, yes, yes.') by different participants. Making sure that all body parts are washed and rinsed properly can be viewed as something of a hassle that should be addressed by making splashing somehow easier. Alternatively, however, it can be viewed as something that is learned as a matter of course if deliberately addressing all different parts of the body is positioned as a way

to relax. Another option of dealing with dislikes is allowing for variety. The issues some participants had with sitting down naked are not a major problem if splashing allows both sitting and standing postures. The issue of missing flowing water is a more tricky one that touches the core of the concept. In spite of the explicit instruction not to use a shower with continuously flowing water, participants found ways to incorporate flowing water in their routine, for example by having a tap above the basin that they left open to rinse their hair or parts of their body, up to several jets that were oozing water from the edges of the basin into the bathroom. However, from the observation that most of the participants, 14 out of 17, did not explicitly mention missing flowing water, it seems that splashing can offer other qualities that can make up for this absence.

The study also resulted in adjustment of the brief for the new stuff for splashing. For example, in terms of water use per splash, it became clear that 20 litres is too large for the basin. A second design requirement that emerged was to explicitly position splashing in a wet space. This positioning is expected to address the dislikes of not feeling clean and creating a water mess at the same time. Feeling satisfactorily clean was hampered by different reasons. One of these was the struggle participants had with managing clear and non-clear water. This management was made more difficult because a number of them felt hesitant to let the floor get wet and make a 'water mess'. They therefore got soap and water rinsed from their body back in the basin, mixing it with clear water. The issue of not feeling clean can therefore partly be tackled by designing the space around the basin and seat explicitly as a wet space. Finally, an issue that seems to be crucial for splashing to work or not as a less resource intensive alternative to showering is the issue of getting cold. Not only had this issue surfaced already in previous studies, even though participants were fully dressed, did not use actual water and were in fact instructed not to feel cold, some of them still complained about feeling cold during splashing. In showering, the body stays warm thanks to a constant supply of warm water, something that exactly lacks in splashing. Therefore, one of the requirements for the redesign is to include some form of heating.

Taking up on these insights, part of the refinement of the practice prototype was done in a master graduation project (Integrated Product Design at TU Delft) by Linus Knupfer for the LivingGreen project (www.livinggreen.eu). Knupfer had himself participated in the GIP study on splashing. Next to this personal experience, he obtained access to both the raw data of the study and the results of analysis by the main author. In addition, he conducted a series of practical experiments in his own home involving a series of objects as shown in Figure 7-22.

The resulting design is shown in Figure 7-23. As can be seen, it is clearly different from the previous design. The basin is

Figure 7-22 Objects used for several experiments by the designer in his own bathroom (Knupfer 2011).

Figure 7-23 Design by Linus Knupfer for LivingGreen project (Knupfer 2011).

reduced to approximately 2 litres and the fixture is designed for easy instalment in existing shower cubicles. A local and quick heat source, in this version an infrared panel, is added in the cubicle.

Another part of the refinement was executed by the author. It entailed the development of an extended vocabulary of splashing (including names of parts of the prototype and descriptions of actions and qualities of splashing) and a basic graphical explanation of how splashing could be done, which was based on the performances in the GIP study (Figure 7-24) and the author's own experiences with using the prototype for a couple of days at home. This enhanced practice prototype formed the starting point for the fourth generative cycle of splashing.
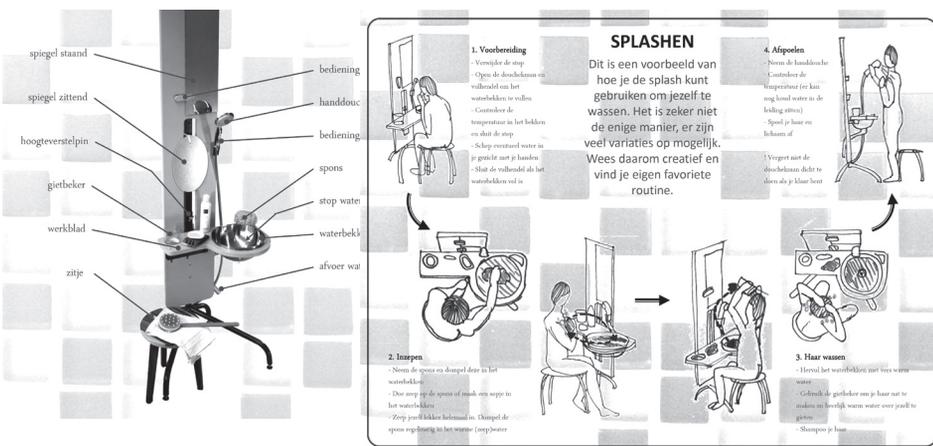

Figure 7-24 Names of parts and use instructions for splashing.

7.3.4   Prototype field studies

The practice prototype developed in the previous cycle was used in two subsequent field studies that mainly differed in their duration and way of gathering data. The goal of the studies was to get insight into the constitution and effects of repeated performance in the settings of daily life. How did subsequent performances integrate different elements in relation to what was expected and in particular, what was the level of warm water consumed. To gain these insights, two studies were set-up entailing installation of the splash prototype into people's bathrooms as a replacement of their shower, and having them use it for one week or one month. These studies were both conducted by the author.

Suggest and trigger

The practice prototype offered to participants included the product prototype made by Knupfer, additional things such as a seat, soaps, a scoop, several sponges and a long brush, and a brochure containing the names of the parts of the prototype and the graphical explanation of splashing. Households were recruited through posters at the local shops in the neighbourhood of the researcher. For field study one, three households were recruited (FamD, FamB and FamS), which were each visited three times. Once to get to know the participants and check whether the bathrooms were suitable for installation of the prototype, a second time to install the prototype and conduct a pre-interview and a third time, after some days of use, to conduct a post-interview and pick up the prototype. For the second field study, one household was recruited through the researcher's personal network (FamA). Next to pre- and post- interviews, it involved an intermediate interview after two weeks. The field studies were preceded by a pilot in the researchers own home. Figure 7-25 contains an overview of the different settings.
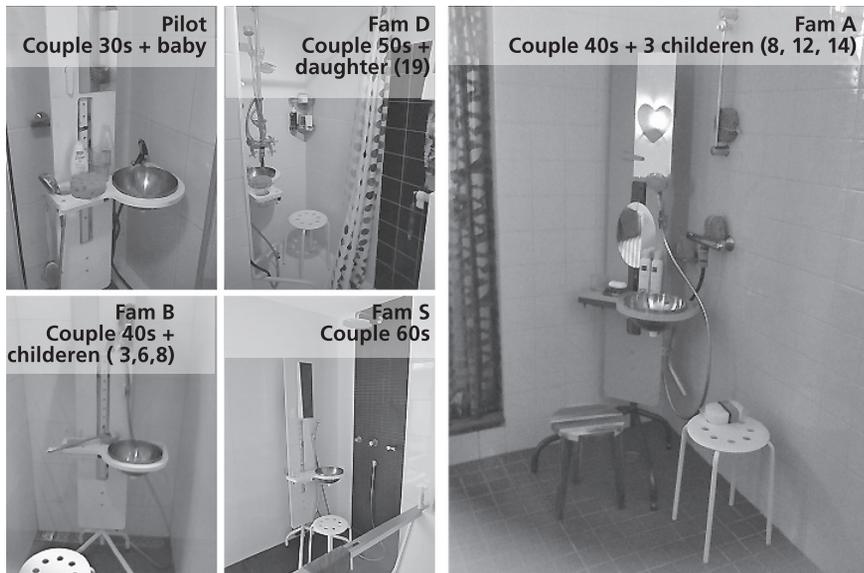

Figure 7-25 Visual impression of installed splash prototype in the participating households.

The performances

In total, splashing was performed 89 times by 14 different participants, ranging from 1 to 15 subsequent performances per participant. Data was gathered through water meters, diary forms and interviews. The first field study used a water meter giving insight only in aggregate water consumption over the course of the prototype's presence in the household. The second field study made use of water loggers and a wireless sender installed to log water use of the showerhead and water basin separately.

Combining, evaluating and refining

Compared to the bucket wash in the experiments in bathing study and the splash concept in the GIP study, this study contained a rather fleshed out suggestion for what splashing is like. Still, variety in the performances was high, for example between Bas, Dina and Astrid.

Bas, who really enjoyed splashing, developed a fixed procedure starting with filling the basin, wetting 'from hair to toes' with one sponge and then soaping his body with the other. He washed his hair in one go with his body. Then he got fresh water and rinsed his hair and body with the scoop. Altogether taking no more than 5 minutes. He first sits down, but when washing his lower body and while rinsing he stood up. He liked splashing for its speed, but also because he thought it felt really good. To quote him 'you clearly use less water than in a shower, but it feels like it is more'. Dina's performance and the way she experienced splashing was quite different. To her, one of the great disadvantages of the splash was that it was taking so much time. During the one time she tried it, she sat down and used the sponge and scoop to apply water to herself, and the sponge to soap and rub her body. Because she got cold, she let the basin overflow, hence the relatively high water use of approximately 100 litres. Similar to Bas, Astrid really enjoyed splashing. Her routine, however, was quite different, as were her reasons for liking it. Astrid started with her toes and worked up to her head. This way she prevented getting cold. For her, washing her body and washing her hair were separate routines. When washing her body, she used only the basin, while for washing her hair, she would place the hand shower in the holder and use that for wetting and rinsing it. While Bas really liked splashing for its speed, Astrid was so enthusiastic about it because it allowed her to really take her time and wash herself deliberately.

Overall, participants sat down and really enjoyed this, or refused to sit because they felt it was awkward. Most combined sitting and standing postures. Also, some participants used only the basin, while others hardly used it at all and washed solely with the hand shower. These latter cases actually form a rejection of the suggested proto-practice, in which washing from the basin is made central. One participant even hung the hand shower above his head, effectively reintroducing showering. This was possible because in the second field study, the push button shower had been replaced by an on/off button shower. Another form of rejecting the suggested proto-practice was found with FamD, where Daniel and Daphne simply used the bathtub and shower combination also present in the bathroom to wash themselves instead of the splash installed in the shower cubicle. According to Dina, they felt splashing was too much of a hassle.

Logging the water use in the long term study confirmed the observation made in the GIP study that washing with contained water decouples consumption and bathing duration, as illustrated in Figure 7-26.

Anton: 23 litres in 4minutes

Astrid: 9,3 litres in 7 minutes


■ basin ■ handshower
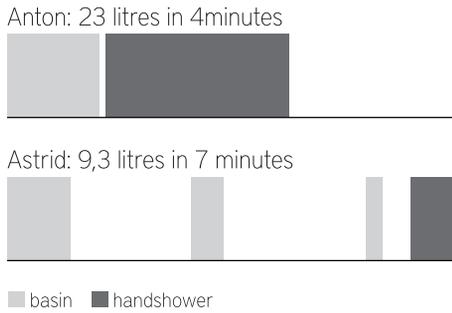
Figure 7-26 Water use patterns of two family members in the second field study.

Water consumption varied from 10 to 100 litres per splash (Table 7-6) with an overall average of 32 litres. Assuming the current Dutch average of bathing 5,5 times per week, this translates to an estimated weekly water usage of 176 litres. When removing the ways of bathing that reintroduced continuously flowing water (thereby rejecting the splash concept) from the consumption data, average water consumption reduces to 12 litres per splash, meaning an estimated weekly usage of 66 litres assuming no changes in average frequencies.

	Aliases	Household composition	No. of days paticipated	No. of performances	Av. water use (litres)
Pilot	Takeshi, Tineke, Taro*	Couple 30s, baby	9	10+9	10
FamD	Daniel*, Dina, Daphne*	Couple 50s, daughter 19	3	1	100
FamB	Bas, Barbara Bob, Bram, Bianca*	Couple 40s, children 8,6,3	6	5+2+1+1	10
FamS	Sam, Sandra	Couple 60s	6	3+3	20
FamA	Anton, Astrid Anke, Anne, Abe	Couple 40s, children 14,12,8	19	15+11+9+8+11	44
			42	89	32

* did not use the splash

Table 7-6 Overview of participants, performances and average water consumption.

The aim of the generative projects is eventually to generate desirable reconfigurations that work. In terms of water consumption, splashing seems desirable, but does or could it 'work'? After the field studies, some further insights were gained into whether it works for people. Table 7-7 contains an overview of how participants evaluated splashing, divided into categories of 'works', 'may work' and 'doesn't work'. When counting only the evaluations of participants above 10 years old, four feel splashing works for them, three that it could work and six that it doesn't, of which two haven't tried it.

Interesting to note is that the participants who enjoyed splashing most also had the lowest water consumption. When looking at responses of participants that felt splashing did not work for them, at least in its current form, two main issues come forward. The first is getting cold. While none of the participants complained about being too warm, there

is such a contraction in the second issue. Part of the participants experienced splashing as too much of a hassle, while others really like the more deliberate way of washing that it invites and enables. Possibly, the issue some people have with this active way of washing disappears when developing a routine that works.

General evaluation of splashing	Participant	Specific explanation	Average water use per splash (litres)
It works for me and I prefer splashing over showering	Bas (Bob, Bram)	It is perfect for me, it is quick and feels really good. It also works really well for the kids	10*
	Astrid	I really like it, I can determine my own speed and feel more clean than from showering	14
	Takeshi	I enjoyed it and feel there is still much to explore about its potential	10*
	Tineke	I really enjoy the feeling of splashing water on me and feel really refreshed	10*
It could work for me, but I currently don't prefer it over showering	Barbara	I really liked the deliberate body care, but got very cold	10*
	Sandra	I really enjoyed it, soaping at your own leisure, but it has to be warmer	20*
	Sam	I enjoyed it and think I could get used to it, it is just that you get cold	20*
I've tried it and it doesn't work for me	Dina	Nice and pampering, but takes too much time and is too much of a hassle	100
	Anton	I don't really see the advantage, and the basin gets dirty from shaving, so then I just shower, it all feels a bit squeezed	56
	Anke	It works to wash quickly, but it is too active and I get cold	43
	Anne	It is not relaxing to hold the shower in your hand and when using the basin I feel cold	26
I haven't tried it, but feel it doesn't work for me	Daniel, Daphne	It is too much of a hassle	n.a.

* household aggregate average instead of personal average

Table 7-7 Extent to which splash 'worked' for the participants in the field studies.

Results of the field studies, together with other data collected on bathing and splashing formed the basis for a redesign of splashing. A master graduation project, supervised by the author, was executed for the European SusLabNWE project (www.suslabnwe.eu). The project was focused on developing a design and working prototype of a splash fixture including integrated heating (Figure 7-27). After exploring several possibilities, the student, Fred Henny, choose a radiator system, which effectively extends the hot water supply of the splash into a tube radiator integrated into the wall mounted vertical element of the appliance. Domestic hot water supply to showers is at least 65°C due to legionella regulations. This hot water is first led through the radiator tube to heat the bather and shower cubicle and then, mixed with cold water, used for washing. The rest of the design remained mostly the same as the previous version developed by Knupfer. The prototype of the design built by Henny was tested both for technical performance of the heater and for use experience through one-time uses in a shower facility of a vacant building on campus. The technical tests, using a thermal imaging camera, show that the radiator heats up to its maximum capacity of around 900 W/m2 (appr. 70°C) in less than 25 seconds. After 13 minutes, the temperature of the 4,1 litres of water in the radiator was still above 40°C, which is warm enough to bathe with. While mainly based on radiation (meant to warm the body of the user directly), the heater also warmed up the space. After about 10 minutes, the temperature in the relatively large space the prototype was installed in rose 1,6°C.

Figure 7-27 The current Splash concept in the form of a working product prototype and a refined design, both by Fred Henny.

In the user test that Henny conducted with 11 participants, an average of 18 litres of water was used, ranging from 7 to 27 litres. Again, a variety of postures and procedures was identified. Two of the participants used only the hand shower. All others used both the basin and the hand shower. Although the heating was shown to work technically, getting chilly or cold was still an issue for some participants. Others felt comfortable or even comfortably warm. To shape and evaluate the integration of the heater in the proto-practice, further tests are required. In the current tests, participants were for example not informed that there was a heater in the product. Explaining about the radiator and the way it works may affect their thermal experience. Moreover, the testing space was relatively large for a shower cubicle; the heater may render more effect in a smaller space, and participants arrived directly from outside to the test location while it was winter so they may have been chilly already.

7.4   Conclusions

Showering is by far the most popular form of bathing in the Netherlands. It is also highly resource intensive. The main culprit for this resource intensity was identified in the paradigm of continuously flowing water. This observation, in combination with the identification of other forms of bathing with lower resource intensities that are based on relatively small reservoirs of contained water, led to the selection of a shift from flowing to contained water as a direction for further exploration.

Splashing was developed through four iterative cycles. The resulting reconfiguration of bathing seems to work for at least part of the people who have tried it, and measurements of water consumption indicate that splashing requires strongly less water and energy than showering. While this all sounds promising, it has to be noted that reaching the (ambitious) target of average weekly water consumption for bathing of 105 litres per person per week would requires an enormous uptake of splashing. Assuming no effect of splashing on average bathing frequencies, no further changes in water consumption for showering and the amount of 66 litres per week as a representative and stable level of water use for splashing, splashing would have to be picked up by 86% of the Dutch population in order to reach it. Judging from the speed with which the shower has overtaken the bath, this is not entirely impossible. When reaching a certain critical mass, splashing could reposition showering and thus catalyse the shift. In such a view, showering requires large amounts of water, can be tiring because you have to stand all the time making it difficult to wash your feet, is inflexible because you have to wet your entire body without being able to direct what is wet or rinsed when, and soap is rinsed off before you've had time to appreciate it.

While the 105-litre target remains highly challenging, not only because of the desired level of uptake but also because of other effects of its introduction - the splash studies show for example that splashing, being a more flexible form of washing may increase frequencies of bathing – splashing nevertheless shows sufficient potential to contribute to reduced household resource consumption to be developed further. Future development of splashing should explore the effects of the heater and longer-term effects of splashing on bathing frequencies and water requirements, while at the same time making available its elements to enable it to spread into society.

8 Staying warm at home

8.1 Introduction

While the staying warm at home projects were less elaborate than the bathing projects described in Chapter 7, especially regarding the generative phase, they were important in developing the ideas and recommendations presented in this thesis. Following a structure similar to Chapter 7, this chapter presents the results of both the analytic and generative phases of the staying warm projects. The chapter shows strong similarities to Kuijer and De Jong (2012), which is an earlier publication that deals with the same topic.

Framing the target practice

Before going deeper into the staying warm projects, a brief note on the framing of the target practice as staying warm at home. Attention for practices of staying warm at home started from the observation that heating of the home takes up the largest single share of household resource consumption in the Netherlands, and tops many environmental organisations lists in terms of CO_2 emissions. During the projects, however, it became clear that 'heating of the home', or space heating may not be the best way of framing the practice. Merriam Webster's online dictionary defines space heating as 'heating of spaces *especially for human comfort* by any means (as fuel, electricity, or solar radiation) with the heater either within the space or external to it' (emphasis added). Ideas about comfort turned out to have a strong relation with ideas about the way the home should be heated and to what temperatures, which is directly related to levels of energy demand. Moreover, these ideas of what is comfortable vary and change over time. It also became clear that keeping the body at a comfortable temperature entails much more than adjustments of the thermostat. A student brainstorm provides an example of the wide range of possible ways to warm the body (Figure 8-1).

Heating Systems: Brainstorm

Hats
Ear Warmers
Clothing
Scarf
Jacket

Heat Blower
Radiation
Central Heating

Love
Anger   **Emotional**   **Personal**
Nervous

Size of Room
Insulation
Environment
Crowd
Orientation of Building

[Heating Systems]

Water Bag
Hot Water Jar
Objects
Compost
Chemicals
Cherry Pits   Sachets   Light
Machines
"Blob"   Motors

Breath
Hugs
Neutral
Sun
Fire   Body Parts
Butt
Armpits

Shower
Baking   **Physical Activity**
Doing the Dishes
Friction
Eating/Drinking

Figure 8-1 Different ways of heating the body (graphic by ITD WARM1 [6]).

In addition, these practices are not purely self-directed. In some cases, other people in the house, members of the household and especially guests, need to be kept thermally comfortable as well, and animals, plants and even the house itself can be more or less 'thermally comfortable'. For example, humidity levels are important for the home's 'comfort'. Over time, framing was therefore adjusted from heating the home to 'practices of getting and keeping the body and/or the house and its contents at comfortable temperatures', which was shortened to practices of staying warm at home or simply staying warm.

8.2   Analysing practices of staying warm at home

Reflecting the approach presented in Chapter 5, analysis of practices of staying warm involved the quantification of consumption parameters, a historic analysis, an analysis of low-resource intensive varieties and mapping the target practice. Figure 8-2 shows the analytic model as a reminder for the reader.

In search for opportunities for desirable change, the section below starts by quantifying consumption indicators for space heating in space and time, which highlights Japan as a country of inspiration. After providing an overview of shifts in Dutch practices of staying warm at home in the past century, Japanese ways of staying warm in winter

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[6] The ITD WARM1 team consisted of Marco Ortiz, Roos van der Schoor, Emiel den Exter, Paul Shen and Tomasso Sarri.

PRACTICES AS A UNIT OF ANALYSIS

Selected target practice

Quantify consumption indicators

Current average, variety, history and target level

Trace historic career

Explore similar practices

Map the target practice

Opportunities for desirable change
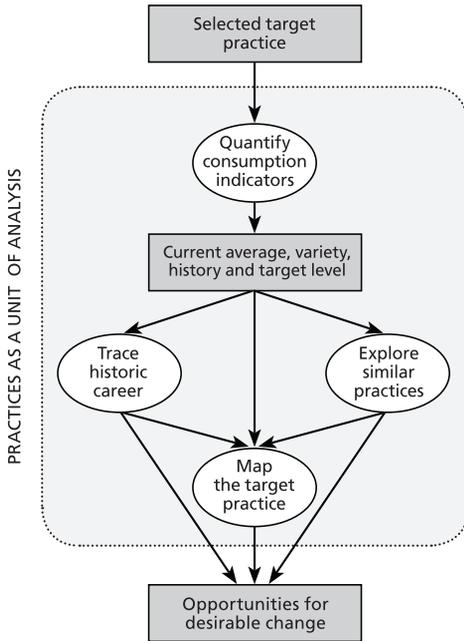
Figure 8-2 Model for taking practices as a unit of analysis and identify opportunities for intervention in a selected target practice (circles represent activities, squares intermediate results).

are described in more detail. Analysis of the target practice points attention to the concept of base temperature as a main indicator for levels of energy consumption and to lowering this temperature as a main goal. However, as will be argued, this can only be achieved when people are offered other ways of making themselves comfortable. The direction selected for further exploration is expanding possibilities for person heating in addition to space heating. This opportunity is taken further into the generative phases described in Section 8.3.

8.2.1 Quantifying consumption indicators: gigajoules per household per year

Resource consumption metrics for domestic heating consist primarily of data on space heating. Data on other forms of staying warm, such as drinking tea, taking a shower, exercising, wood stoves or electrical heaters is much more difficult to find. Moreover, such data is very difficult to isolate – what percentage of a shower is for getting warm and what percentage for getting clean? Because these forms of consumption take up a relatively small share compared to energy use for space heating, they were not taken into account in this analysis. Consumption metrics for space heating are expressed in kWh or Joules per household per year. To make metrics comparable, here the unit of Gigajoules (GJ) per household per year is used. Because household size has decreased over the years, the historic overview also compares metrics per person per year.

Historic trends

When looking at the available data, the total of energy consumption for space heating in the EU increased between 1990 and 2000 and has since decreased (ENERDATA 2011). Energy efficiency of dwellings has clearly improved since 2000, but this trend has been offset by an increase of 20% in floor space per person and an increase in the number of households (EEA 2012). The Netherlands has seen similar developments, but below consumption indicators are traced back further in time.

When looking at energy consumption for heating in the Netherlands in the past century, there was a strong rise between 1920 and 1973, followed by a decline lasting until today. This development is visualised in Figure 8-3. Although precise data is lacking from before 1950, a 1929 household manual estimates an energy demand of 200 MJ per

Figure 8-3 Historic energy demand for domestic heating in the Netherlands (including water heating) (Overbeeke 2001, Van der Wal and Noorman 1998) [replace with per person figure].

3 days to heat an average Dutch dwelling (Overbeeke 2001: 59). Assuming a heating season of 7 months, this comes down to 14GJ per household per year, or 3,5 GJ per person. When calculated per capita, energy demand for space heating increased from 14 GJ per person per year in 1950, to 37 GJ in 1980, and then decreased to a level of approximately 26 GJ in 1995 (Overbeeke 2001). In 2010, this had decreased a little further to 23GJ per person per year (ENERDATA 2013), but a Dutch report shows a slow increase in energy consumption for heating between 2007 and 2010 (Van Dril et al. 2012:14). Data on heat consumption from before 1900 is difficult to find, but a historian's remark that in the 17th century, 'a Dutch house gave foreign visitors the impression of being hardly heated at all' (Zumthor 1994) indicates that it was lower than today.

In 2010, space heating accounted for 51% of energy use in Dutch households (MilieuCentraal 2010) and across the EU the share is even 68 % (ENERDATA 2011). It can be concluded that although energy consumption per household has decreased over the past 30 years, heating still accounts for the largest share of energy consumption in households and some data show increasing trends again.

Variety

Energy used for heating varies greatly between households. In a study among energy efficient homes in the Netherlands involving ten different housing projects of newly built homes, the minimum yearly use was 299m^3 and the maximum 2199m^3. It must be noted that this was for different homes with different household sizes, the latter being a 6-person household, but it does show that consumption levels can vary greatly. Moreover, within one housing project though, the spread was still 299m^3 to 912m^3, meaning the highest consuming household using three times that of the lowest (Jeeninga et al. 2001). To explain this difference, the study points to the behaviour of the inhabitants, and in particular the temperature settings and number

of rooms heated. Similarly, but more general, a report by the Dutch Energy Agency (Van Dril et al. 2012) shows a spread in overall gas use per household from under 200 to over 5.000m^3 per year. For reference, the average Dutch gas consumption for heating was around 1200m^3 per household per year in 2010 (MilieuCentraal 2011).

Figure 8-4 visualises some of the variety that exists between average energy consumption levels for heating homes in different European countries, corrected for differences in climate. It shows for example that in Luxembourg, households use 4,3 times as much energy as in Malta, and the Netherlands almost 3 times (ENERDATA 2013). Looking beyond European borders, differences become even higher. In Japan, a country with similar wealth levels and a slightly warmer but similar climate to the Netherlands (3,3°C in winter compared to 5,1°C), average energy demand for heating of dwellings was 12GJ per household in 2001 (Nakagami et al. 2008), while in this same year, energy demand of Dutch households was 50GJ (ENERDATA 2013).
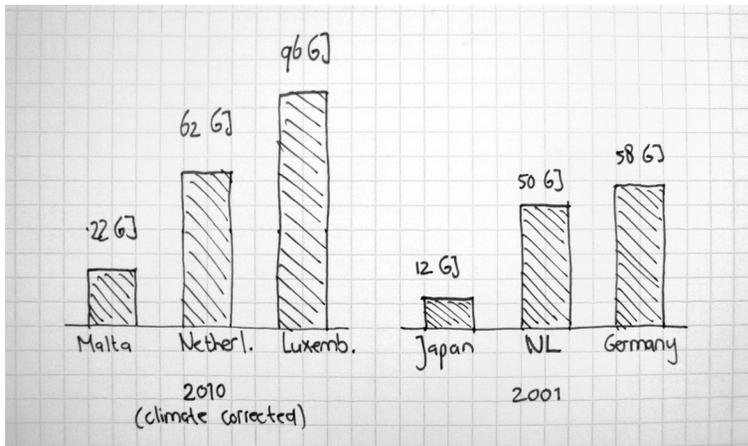
Figure 8-4 Visualising ranges of variety in energy demand for heating of dwellings per year.

Basic heating needs

Like in the bathing projects, these large differences in demand for resources lure up questions of what is actually needed, in terms of energy, to stay warm at home. The BASIC project has calculated basic heating needs (Zhu and Pan 2007). To do this, they use heating degree days (HDD), average floor area of dwellings and energy intensity per square meter. Average floor area in the Netherlands was 107m2 in 2010 (ENERDATA 2013), and over the past three years HDD per year was 2267 when assuming a 15.5 base temperature (degreedays.net). The heating season in the Netherlands runs from October 1st to May 1st. In Japan, heat requirement per HDD per square meter was 80 KJ in 1998 (Zhu and Pan 2007). This brings the basic energy requirement of a Dutch household to 107x2267x80 = 19,4 GJ per household per year. It has to be noted that this calculation contains many assumptions, for example that the entire home is heated at the same level. However, like in the BASIC report, the calculated value is meant as a heuristic to illustrate the direction and order of magnitude of potential energy savings, not as a target to be imposed on Dutch households.

Summing up, energy demand for space heating has shown a sharp increase between 1920 and 1973 after which it has declined again to stabilize, at least temporarily, at a level of approximately 50GJ per household per year. Variety in energy demand for heating can be extensive between different countries, even when climate differences are levelled out, but also between neighbours living in similar homes demand can differ by a factor three. Japan seems to be an interesting country for further study, because of its relatively low energy demand for heating combined with a relatively high standard of living and similar climate. Different forms of variety suggest saving potentials between 50% and 75%, towards a target level of an average energy demand of 20 GJ per household per year.

In order to get an idea for what staying warm at home in the Netherlands requiring around 20GJ per household per year could be like, and how the shift could be made from today's mainstream practice to more desirable forms of staying warm, it is important to first learn more about how the practice is currently constituted, and how less the resource intensive varieties identified in this quantitative analysis work or have worked in the past.

8.2.2 Tracing historic career: a century of shifts

As reflected in the consumption metrics, major changes have occurred in practices of thermal comfort in Dutch homes over the past century. Trying to understand these changes from a practice theoretic perspective, literature study and two interviews with couples from previous generations (one born in the 1920s and the other in the 1950s) were conducted. From these sources, it becomes clear that a key moment in the history of heating in the Netherlands has been the discovery of large amounts of natural gas on Dutch territory in 1962. Accompanying changes can be summarized into four shifts that had consequences for the constitution of elements in the practices. Because the practices developed particularly rapidly between 1920 and 1990, the overview focuses on this time span. The shifts are discussed below and summarized in Table 8-1.

From solid to liquid fuels
The first shift is from solid fuels to liquid fuels. It started around the 1920s when gas and oil emerged as alternatives to coal, but took a surge with the discovery of the natural gas field in 1962. Overbeeke (2001) ascribes the origin of the shift to the availability of oil stoves, which were first developed in the United States. Oil and gas heating was more expensive, but involved less work and skills on the side of the household. For example in the home of one of the interviewees, the main stove in the house was first fuelled by coal, kept in the coal shed which was fed into the stove by the maid. Later, when they switched to oil, a pipe from the oil barrel in the garden fed into the stove directly. In practice terms, the shift entailed changes in material things (coal-sheds and scuttles were replaced by pipes, coalmen had to find new jobs, coal carriers new functions) and in division of competences (carrying fuel to the stove was now done by pipes, skills of making and maintaining a good coal fire were no longer needed and with that, fuel and temperature management were delegated to a gas meters and knobs). Together with all this, conventions for the amount of work and hassle (coal dust, cleaning the stove) involved in one's indoor climate decreased strongly.

From local to central heating

The second shift is from one heated (living) room to (central) heating of the entire house, which like the first shift started slowly in the 1920s but really took hold after the introduction of natural gas in the 1960s. This shift was fuelled by government campaigns, aimed to sell the natural gas. By 2012, 86% of Dutch households had natural gas based central heating (Van Dril 2012). Overbeeke (2001) connects the shift to central heating to an increase in free time, which left time for hobbies and study at home. While family members would first gather in the living room on winter evenings, they now spread over the house with their own activities. Small additional heaters or hot water bottles that were first used for additional heating outside the living room started to disappear and expectations of normal bedroom, bathroom (if the house had one) and study room temperatures changed. One of the interviewees, born in a well to do family in 1950 remembers their home had a central heating system. The main stove was situated in the kitchen and fed warmth to radiators throughout the house. In addition, the house had a wood fuelled hearth and a coal stove in the back and front living rooms, which were the main living areas of the family. Another interviewee moved into a newly built home in 1964 when aged 11, which was equipped with central heating. However, she mentions that for doing homework in her room, she still used an additional small heater to be warm enough. These small heaters were electric or oil fuelled, or they were hot water bottles or the so-called 'stoof', a coal heated footwarmer.

From body to space insulation

Thirdly, a shift from insulation of the body by clothes to insulation of the living space in the building envelope can be identified. The introduction of central heating has already made warm clothes for bedrooms less necessary. Improved insulation, especially introduced in the 1980s as a response to the oil crisis and reports like Limits to Growth (Meadows 1972), has strongly reduced cold draughts, further allowing for lighter clothing indoors. Additionally, thermostats can now make sure the home is heated before getting up in the morning or before getting home from work. With this shift, not only warm clothes like the 'borstrok' (under vest) went out of sale or were no longer made. Routines of dressing changed, and skills of how to dress warm disappeared. Lighter ways of dressing in turn, assume – expect as normal – certain indoor climate conditions.

Towards automation and standardization

The most recent shift is mainly taking place in offices and public buildings, but its effects are also becoming apparent in the domestic sector. It is a shift towards increased automation and standardization of indoor climate conditions, which is according to Chappels and Shove (2005) based on an idea of thermal comfort as a universal physiological condition of the human body that can be measured and determined through experiments. Influential in spreading this view have been a series of industry-funded experiments that first took place at the start of the 20th century, which resulted in standards to guide the design of buildings and indoor climate systems that are still used today. A well-known and widely used model is the predicted mean vote (PMV) model developed by Fanger (1934 – 2006) in the 1960s. According to Fanger, the model makes it possible 'for any activity level and any clothing, to calculate all combinations

of air temperature, mean radiant temperature, relative velocity and air humidity, which will create optimal thermal comfort for man' (Fanger 1970: 15). In this view, comfort is then seen as the properties offered by the surroundings and the focus is on averages, standardization and uniformity. People are considered as more or less passive receptors of this comfort.

Not only have these standards of maintained indoor temperatures had a great influence on (building) design. They have also created conditions of inherently mechanized comfort that people have come to expect (Shove 2003). Research by Brager and De Dear (2000) including 160 different office buildings showed that occupants of air-conditioned buildings – as opposed to naturally ventilated buildings with higher varieties in temperatures – have developed higher expectations for thermal consistency; they were twice as sensitive to thermal conditions deviating from the 'optimum'. These expectations that developed in mechanically cooled and heated buildings stay within a relatively narrow temperature range and require more cooling in summer and more heating in winter than expectations based on natural ventilation conditions. Rather than offering comfort, these technologies strongly influence what is considered comfortable, thus creating a 'need' for mechanized heating and cooling.

While initially focused on office environments, technologies for heating homes are now also converging towards increasingly inflexible systems. Central heating is already widespread and floor heating is (slowly) on the rise for newly built homes, stimulated by policy measures as an environmentally desirable building option (Kleefkens 2008). Newest developments are heat pumps in combination with low-temperature-heating (LTH) in floors and walls (MilieuCentraal 2011). These systems take a long time to warm up and therefore work best when on constantly. In combination with tight insulation, these systems offer a uniform air temperature.

Overview of shifts in practices of staying warm at home

Table 8-1 offers an overview of the four shifts described above and summarizes how each shift has both recruited unfamiliar elements and rendered other elements obsolete.

The four shifts identified in practices of staying warm at home that have taken place in the past century (and are still going on) illustrate how skills have been delegated to technologies and how the stuff for staying warm has gradually moved away from the vicinity and attention of people into the background. Like in the case of bathing, infrastructures (of gas supply) play an important role in setting standards, in this case of a domestic central heating system requiring little to no attention of the inhabitants. Homes and heating technologies have become more efficient in offering a warm indoor environment. What this overview also reveals are a number of opportunities for less resource intensive practices or elements that could further reduce energy demand for staying warm at home. Examples are the more direct relation of people with fuel supply, centralized family activities and skills of dressing warm and viewing comfort as an achievement rather than as offered by the building envelope.

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		Intervention	Images	Skills	Stuff
From local to central heating	IN	Higher standards of living, discovery of gas field	Expansion of living space, clean, easy, dry	More free time, studying, hobby's	Additional heaters, central heating, natural gas, pipes, radiators, central thermostats, higher fuel consumption
	OUT		Cosy, cheap	Family gathering in living room	Stoves, humidity, hearths, thick blankets, bed warmers
From solid to liquid fuels	IN	Introduction of oil stoves	Easy to use, energy saving, fire hazard	Good design, proper installation, fire safety turning on and off, 'flumping'	Oil barrels, oil pedlar, thermostat, pipes
	OUT		Cosy, safe	Daily fetching of coal, mending fire, on continuously, cleaning stove	Dust, ash, coal shed, scuttle, poker, large fuel stock
From body to space insulation	IN	Energy crisis, environmental concerns	Cosy, energy saving, high investment, poor air quality	Proper ventilation, lower temperature settings, programmed thermostat	Wall and roof insulation, double glazing, high efficiency heaters, light indoor wear, rising CO_2 and humidity levels
	OUT			Ways of dressing warm, making warm clothes	Warm clothes, thick curtains, cold draught
Towards automation and standardization	IN	PMV model	Comfort as offered by surroundings, expectations of uniform temperatures between 20 and 23°C	Managing of indoor climate delegated to HVAC designers, installers and building managers	Automatic thermostats, balanced ventilation, automatic sun shields
	OUT		Comfort as achievement, expectations of comfort related to outdoor temp.	Skills of making oneself comfortable	Natural ventilation, open windows

Table 8-1 Shifts in constellations of elements of practices of staying warm at home.

infrastructures (of gas supply) play an important role in setting standards, in this case of a domestic central heating system requiring little to no attention of the inhabitants. Homes and heating technologies have become more efficient in offering a warm indoor environment. What this overview also reveals are a number of opportunities for less resource intensive practices or elements that could further reduce energy demand for staying warm at home. Examples are the more direct relation of people with fuel supply, centralized family activities and skills of dressing warm and viewing comfort as an achievement rather than as offered by the building envelope.

8.2.3 Exploring similar practices: domestic heating in Japan

Based on the analysis of consumption indicators, Japan emerged as a country with relatively low energy requirements for domestic heating but similar income level and climate conditions to the Netherlands. To find out how the Japanese stay warm at home and how these practices relate to the relatively low consumption level, literature study was conducted, supplemented with a small-scale observational research in Japan. In December 2009, the author visited Japan and had the opportunity to stay in four different households, each for two or three nights. During these visits, informal observations and interviews were conducted regarding the ways in which these households dealt with their indoor climate. The households were two family homes with grown up children, one couple and one single household. Two of the households were in Tokyo and two were in the countryside of the main and southern island. The two households in Tokyo were in apartment buildings and the other two were freestanding houses in suburbs. As a main result, the study revealed a basic difference between practices of staying warm at home in the Netherlands and Japan, where the first is based on space heating and the second on what is here called 'person heating'.

Person heating in Japan
Although the practice of space heating is gaining ground, Japanese generally and historically adopt more person-oriented heating practices. Because heating the entire house at once 'was never on the table' (Brown 2009), a great diversity of more local heating systems can be found. Still today, Japanese tend to heat only one room in the house or even just the part of the room they occupy (Wilhite et al. 1996). Heating the room locally is traditionally done by means of a 'kotatsu'; a low table covered by a comforter that is wrapped around the waist area and captures the heat of the heating unit placed under the table. Other examples are the hibachi – a portable charcoal fuelled heater designed to sit close to for warmth, and the widespread habit of heating the toilet seat instead of the entire toilet space (Brown 2009: 173), electric carpets – which are slowly replacing the kotatsu – and the 'yuutampo', a type of hot water bottle (Figure 8-5). The latter is aptly described in a Sunday Times article as one of the most 'low-tech' products imaginable with 'only one moving part (the lid) and the simplest of user manuals (fill with hot water, then snuggle)' (Lewis 2008).

Figure 8-5 Image: Galerie Japankunst, Munchen (hibachi), Storm-from-the-east.com (kotatsu).

Even more direct than a local heater is the bath or 'ofuro' (described in more detail in Section 7.2.3), which plays an important role for staying warm in the house. The Japanese are housed smaller than the Dutch, and rooms used to be and still are often multipurpose (Daniels 2010). The 'futon' is an example of a product that is interwoven with this condition; a foldable bed that can be spread out in the evening in a space used as a living room during the day. These multipurpose rooms have also made it necessary for other furniture and appliances to be easily portable and moved out of the way, such as for example the hibachi and other portable heaters. Instead of the slower radiator based systems now common in the Netherlands, rooms are mostly heated with air-conditioners, which blow warm air in the room, thus heating it up relatively quickly. If a house has separate bedrooms, they are usually not heated, possibly because family members take a hot bath before going to sleep, but small heat sources are also used to warm up the bed.

All of these aspects make that Japanese are used to entering a cold room and have strong habits of turning off the heat at night, or when they leave a room or the house (Wilhite et al. 1996). These insights confirm that the framing of domestic heating practices as 'space heating' may be too narrow, because it misses important opportunities for change. The extended framing of staying warm at home opens up opportunities in the area of person heating, such as practiced in Japan.

8.2.4 Mapping the target practice: current ways of staying warm

Having placed practices of staying warm at home in a historic and cross-cultural frame of reference, it is now time to dive deeper into the details of contemporary Dutch ways of staying warm and their relation to current levels of direct resource consumption. Next to literature study, this exploration involved a workbook and interview study among 60 Dutch households. They were recruited in the context of a master course by 14 student groups. Each group recruited 5 to 6 participants, all residing in the Netherlands, varying in gender, type of home, type of ownership of the home (tenant/owner), size of household (1-15), age (19-70), nationality and occupation. Participants received a workbook that was developed by the author containing questions related to their thermal comfort. The workbooks were used in a subsequent video interview in the participant's homes. The study was conducted in February/March 2010. Three themes emerged from the study: variety in temperatures, balancing draught and ventilation and ways of getting warm.

Variety in temperatures

Most participants had a 'standard' central heating system, some had floor heating or gas stoves. Differences were found in how people experienced the thermal comfort of their homes. There was a group with clear 'thermal issues', expressed for example as: 'My indoor climate sucks. I have cold fingers all the time'. These cold indoor climates were mostly attributed to poor insulation, mainly of the windows, causing cold draught. Contrasted to too cold, some participants complained about being too warm. Especially in case of shared houses due to heat from neighbours and limited or no control over thermostat settings. Notable in people's descriptions of their indoor climate was their focus on a combination of radiators and windows. Windows are contrasted to radiators and experienced as sources of cold (Figure 8-6).
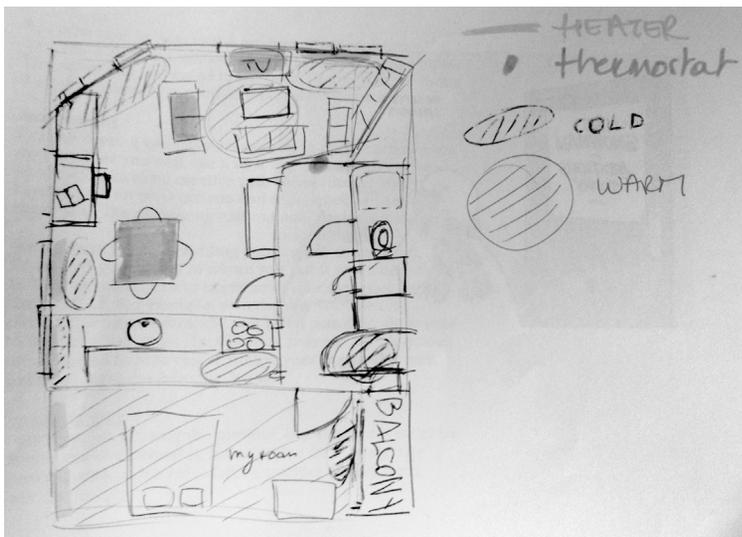
Figure 8-6 Map of an apartment with cold and warm places drawn by a study participant.

Exceptions to this point were participants living in newer, well insulated houses with floor or wall heating; they could not indicate colder and warmer places, at least within one room. Additionally, most participants indicated that different rooms in the house were kept at different temperatures, with bedrooms and hallways lower than living rooms, kitchens and bathrooms. Temperature settings for living spaces, when mentioned, range from 18 to 23°C. for other spaces and during night or when away, temperatures range from 15 to 18°C, or below that when heating was simply off. Even with central heating, the temperature in the house is not (experienced as) or preferred to be uniform.

Balancing draught and ventilation

While draught is considered negatively as a source of cold, closing off the home entirely from outdoor air supply is not desirable either. This type of cold air can also be called 'fresh air', which is welcomed into the home through ventilation. Ventilation is considered

important, both for safety reasons (that are apparently well-known according to one of the participants: 'We ventilate well (for risks known)') and to create a comfortable mix between a warm body and fresh air. This point is nicely explained by a participant who describes a comfortable situation as 'when my room is still slightly cold but I have a blanket wrapped around me'. Another participant mentions to ventilate daily for a few hours. Some of the student groups conducting the studies also observed this contradiction and one even claims that 'the main problem people encountered is that the heater has a side effect. People didn't like the dry and stale air inside the house'. While improved insulation of homes has reduced heat loss and in parallel, draught, there seem to be limits to the levels of insulation that are considered acceptable. Draught is unpleasant, but when it is called ventilation, it is good and necessary. Windows are left ajar even in winter and a warm body in combination with fresh surrounding air is a preferred condition of comfort.

Ways of getting warm

Thermal comfort is something that mostly exists in the background. It only comes to the surface in situations where people feel uncomfortable, which in winter mostly means too cold. Moments of cold are primarily moments of passivity, when watching television or working behind a computer, or they occur in cases of sudden changes in temperature when just getting out of bed or when just entering it, getting home from the cold outside, or when getting out of the shower. For such cases, participants mentioned a small and recurring selection of ways to get comfortably warm again, being turning up the thermostat and wearing extra clothes – usually meaning a sweater and often also something for the feet like slippers or extra socks. 'Too much' additional clothing, however, limits freedom of movement and conflicts with a sense of fashion; coats are not acceptable as indoor wear for example. Also quite common was using a plaid or blanket, e.g. on the couch when watching television. A minority of participants mentioned additional strategies such as warm drinks, being active, cuddling, hot water bottles and small (electric) heaters, taking a warm bath or shower, moving closer to the radiator and closing doors and windows.

Connecting consumption levels and practices of staying warm

Heating the home is the largest energy consumer in households. This energy demand cannot be attributed entirely or even primarily to people temporarily turning up the thermostat when they feel cold. Rather, it is the base temperature at which the house is kept that accounts for the bulk of demand. In the study, these base temperatures ranged from 18 to 23°C, but most participants, while specifically asked, did not even mention a particular temperature when describing their home's indoor climate. People mention variety, for example in settings for night time and times of absence and differences in base temperatures between different rooms, but the base temperature, set at some point, seems a non-negotiable condition that is expected in these practices. This increasingly counts for homes with Low Temperature Heating systems that need to be kept at a constant temperature to work properly. What participants did not agree on was what an acceptable base temperature is. For some, 18°C is perfectly fine, while for others, 20°C is a bit on the chilly side. A difference in base temperature of 5°C (as measured in this study) corresponds with considerable differences in energy consumption. Campaigns

for saving energy have identified this opportunity and advice people to turn down their thermostat by one degree. However, what these campaigns do not take into account is the way each household's base temperature is taken for granted and related to, for example, the ways people are used to dress indoors. Moreover, a risk of these campaigns is standardizing acceptable indoor temperatures at levels above current averages by implicitly communicating certain temperatures as the norm. A quick search for images using the query thermostat + saving energy shows temperature settings as high as 23.5°C.

When turning down the thermostat, people will feel cold more often. This is where insight into strategies for staying warm comes in. To cover for moments of cold that unavoidably occur when variety between people and what they do contrasts with the base conditions offered by the home, people have developed several strategies. Next to temporarily turning up the thermostat, adjusting levels of clothing is a common response. However, it has also become clear that there is a limit to the levels of clothing considered acceptable. Additionally, the study indicates that turning down the thermostat can have advantages other than saving energy. Considering peoples preference for fresh air, a lower indoor temperature in combination with appropriate strategies for keeping the body warm could make people eventually more comfortable. These observations can be summarized in terms of strong links and core elements, threats and trends and tensions in the practice:

Strong links and core elements of staying warm at home
- Infrastructures of gas supply and central heating systems
- Expectations of a certain minimum indoor temperature provided by some form of space heating
- Images of heating as something in the background requiring little work
- Thermal comfort and ways of dressing

Threats and trends regarding resource consumption
- Move towards low temperature heating systems with uniform climate conditions
- Increasingly uniform expectations of indoor temperatures that require heating in winter and cooling in summer

Tensions in the target practice
- Tension between ventilation and draught
- Tension between ideas of fixed climate conditions and high variety in need for heat
- The preference of fresh air and a move towards increasingly air tight space insulation
- Tension between advice to turn down the temperature and taken for granted base temperatures.

8.2.5 Identifying opportunities for change: practices of person heating

Although energy consumption related to staying warm at home has decreased in the past 40 years, approaching consumption levels similar to the 1950s, practices of staying warm at home today are in many respects different. Reductions have been achieved through improvements in insulation of buildings and efficiency of heating installations, but they could have been much greater if consumption of heat had not increased so sharply between 1950 and 1980. The savings that can be achieved through improved insulation and heater efficiency are reaching their limit and energy consumption for heating has increased again in the past years (Van Dril et al. 2012). Additionally, based on views of comfort as something offered by the house, indoor climates are becoming increasingly uniform raising dependence on mechanized heating and cooling.

Having identified these developments, Chappells and Shove propose a shift towards approaching comfort as a 'highly negotiable socio-cultural construct' (2005: 32). Comfort is then seen as a (collective) achievement rather than an attribute. They argue that an implication of this view for policy, which could equally apply to design, is that instead of providing specified comfort conditions, one should 'provide opportunities in which people make themselves comfortable' (2005: 34). These more flexible interpretations of comfort and the ways in which it can be achieved are expected to introduce more elastic concepts of comfort, thus changing what are normal standards and expectations for indoor climate. In addition, this view acknowledges the high inter- and intra-personal variety that exists between (thermal) conditions that are considered comfortable (Van Hoof 2008). In contrast to predictions of the PMV model that state people are comfortable between 20 and 23°C (ISO NEN 7730 2005), studies worldwide have found people reporting to be comfortable in temperatures ranging from 6 to 40°C (Goldsmith 1960, Höppe and Seidl 1991, Nicol et al. 1999). Similarly, Brager and De Dear (2000) propose an adaptive model for designing climate systems based on outdoor temperatures, suggesting indoor temperatures, during winter, between 16 and 23°C (and up to 32°C in summer). This expanded range of comfortable indoor temperatures opens up opportunities for strongly reducing base temperatures. A challenging target in line with the 70% reduction objective could for example be 16°C. However, reduced indoor temperatures can only work when occupants are offered sufficient means for creating their own comfort in other ways.

An important insight emerging from the analysis is that in ways of heating, a distinction can be made between space heating and person heating as two extremes on a sliding scale. Space heating heats the *room*, through convection, radiation and/or air-conditioning and involves a time-lag; when turning on a radiator or stove, it takes some time for the room to reach the desired temperature and warm up the people in it. The most 'extreme' form of space heating found is low temperature heating. Person heating heats the *body*. Theoretically, the most 'extreme' form of person heating is heat generated within the body itself, which can be increased through being active. Externally, a hot drink or food may be considered as the most direct form. Next are small portable heat sources like the hot water bottle and the 'stoof'. In between person and space are heat sources that are more or less fixed in a room but still local, like an electric carpet, small electrical stoves or a 'kotatsu'. Figure 8-7 summarizes the different forms of heating on a scale from space heating to person heating.
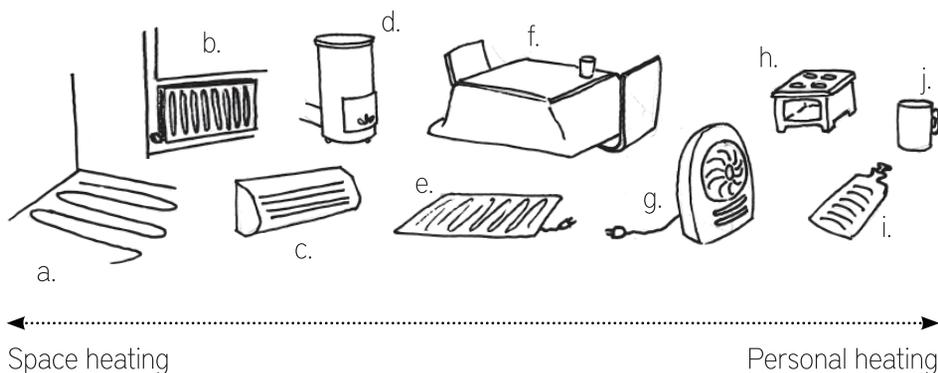
Figure 8-7 Forms of heating on a scale from space heating to person heating
 (a. floor heating, b. radiator, c. air conditioner, d. gas stove, e. electric carpet, f. 'kotatsu',
g. portable heater, h. 'stoof', i. hot water bottle, j. hot tea) (Kuijer and De Jong 2012).

In practice terms, the studies show that person heating practices entail small, local heaters that quickly warm up, skills of dressing warm, more central family activities and habits of turning off the heating when leaving a space. In terms of images, it is normal to enter a cold space and spaces are viewed relatively ambiguously in terms of their function. In contrast, space heating practices involve central heating systems that warm up slowly, high levels of space insulation and light clothes. Skills involved relate to dealing with the thermostat, thinking ahead on family schedules and habits to dress light indoors. Images entail expectations to enter a warm space and low hassle; heating technology does its work in the background and is only interacted with in exceptional situations.

While lowering the base temperature is key to reducing energy consumption for heating, the bird's eye view exploration of practices of thermal comfort has revealed many interesting directions for sustainable design that look beyond the setting of the thermostat. Some examples of less resource intensive heating practices are: more direct relations with fuel supply, centralized family activities, warm clothes and clothing styles, active versus passive activities, images of fresh air, multipurpose rooms and person heating. Without discarding other directions, it was decided to continue with person heating. The reason was a parallel observation that Dutch ways of staying warm at home or heating practices are increasingly based on paradigms of space heating. When variety is the goal, expanding ways of achieving thermal comfort towards the 'person heating' side of the spectrum – combined with a reduction of indoor base temperatures towards 16°C – seems to be a promising direction.

## 8.3 Reconfiguring practices of staying warm at home
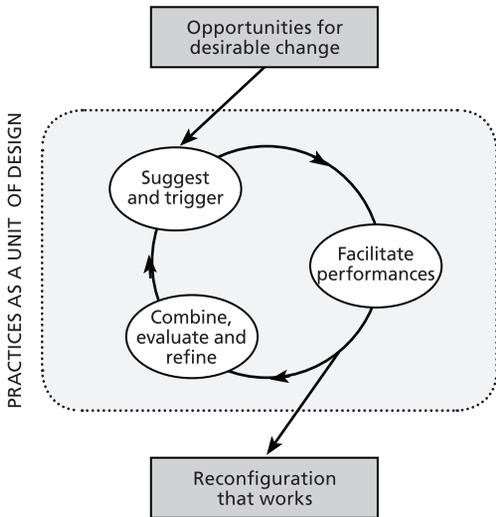
Figure 8-8 From opportunities for intervention to reconfigurations that work; practices as a unit of design.

The opportunity of supplementing space heating with person heating practices was fleshed out in two subsequent generative cycles that followed the model proposed in Chapter 6 (Figure 8-8). This model is here included for the reader's reference.

The first cycle involved a so-called trigger-product study and four student design projects. The second generative cycle was still ongoing by the time of concluding this PhD thesis, but because it involved a particular type of generative method that makes use of a 'Living Lab' setting, its set-up and intermediate results are included in this chapter.

8.3.1 Trigger-product study

The aim of the trigger-product study was to gain insight into how person heating, as a way of staying warm may work in Dutch households. From the analysis of practices of staying warm, insight was gained into how person heating practices worked in the past and how they work in Japan, but because the socio-cultural setting is so different, little can be said about how they may work in current day Netherlands. The main idea behind the study was to roughly prototype person heating as an addition to space heating in the Dutch cultural setting.

Suggest and trigger

The study was designed by the author and conducted by master students in the context of a course on observational research. It involved the same 60 households recruited for the analysis of current practices of staying warm at home. The proto-practice of person heating was presented to participants primarily in the form of a so-called trigger-product. A product was selected that offered opportunities for person heating in the form of an individual, mobile, discontinuous radiant heat source, being a small size pillow filled with cherry stones that can be heated in the microwave, in an oven or on the stove. Participating households received the cherry stone pillow to use for two days (Figure 8-9), with the instruction to 'try out the product and see how you can use it as a way to keep warm (e.g., when working, watching TV or sleeping)', to 'be creative with the product' and to report on how they use it and how they experience this use. The study was closed with video interviews in people's homes, in which the workbooks were used to guide

Figure 8-9 Materials of the trigger-product study, including a cherry stone pillow and workbook.

and support the interview. In the video interviews, participants were asked to re-enact what they had done during the two days.

The set-up does not aim to evaluate the trigger product as a 'sustainable innovation' or a 'solution' to achieve reduced energy consumption for the target practice. Rather, the product was brought into Dutch homes to explore what types of uses would emerge and how these may fit in or conflict with existing practices, to elicit a variety of bodily responses and the evaluative reflections they evoke. The focus in this study was on practices of person heating as an addition to existing ways of staying warm. Therefore, its potential for reconfiguring what are considered acceptable indoor temperatures, i.e., lowering base temperatures, was only marginally explored.

The performances

As expected from accounts of the participants on when and where they felt cold, the pillow was widely used when passive at home; sitting behind a computer or watching TV. Bedrooms were not heated or only modestly in the homes studied, so the product was used to warm up the bed before or during sleeping. On these occasions it was placed in the neck, on the lower back, on the lap, under the feet and kneaded or held in the hands. Although only done by a few participants, when carrying the pillow around, this was done in pockets, sweater hoods, a rope or a scarf. In one case, the pillow was used to overlap the time for a room warming up or replace turning on the heater in the short time between getting up and leaving the house in the morning. Several participants reported taking or wanting to take it outside. Other than to purely warm the body, it was used for muscle aches and to play with it by fiddling it in the hands. Several participants wrapped the pillow in a towel to make it more hygienic, less hot, or cool down less quickly.

A recurring issue participants mentioned to have with the product was related to hygiene. The personal heat source was used close to the body and on different parts of the body. Because people did not have a stove and heating on the radiator took too long, it was mainly heated in the microwave. However, the microwave is associated with food and more often than not contains food smells or food remains. Therefore hygiene concerns arose, which also came up because the product invited use under the feet as well as on other body parts like neck and hands. As mentioned, some participants dealt with the hygiene issue by wrapping the product in an additional cloth. However, there is a challenge in making a form of person heating and negotiating ideas of hygiene.
The heat properties of the product were experienced as rather poor in comparison to the effort required for heating it. In other words, conflicts arose with images of acceptable work involved in staying warm. The product was felt as rather hot (50°C) just after heating, but cooled down relatively quickly (in 15 – 20 minutes) and was found too small to properly heat the body – it offered 'body part' heating rather than 'entire person'

heating. However, as anticipated, participants mentioned that they liked the type of direct body heating that kept their body warm and the air around them 'nicely cool and fresh'. Although not looked for explicitly in this set-up, the study also generated insights into undesirable paths person heating practices could take. The fact that some participants took the product outside poses a considerable challenge, because it indicates that person heating products could facilitate increasing expectations of taking indoor comfort conditions outside, thus causing a so-called rebound effect. This shift was already identified in several areas (Hitchings 2009), for example manifesting in heaters on the porch or in the garden. Secondly, a practically unanimous dissatisfaction was found with the 'immobility' of the product. This may be related or somewhat confused with the difficulty participants found with fixing the product on certain places on their body. When putting the product in the neck for example, it fell off easily when moving only slightly and under the feet it would not move along in natural wriggling. A potential challenge could be that this form of heating immobilizes people, increasing the need for heat at home further, because being active reduces the need for heat. The Japanese kotatsu, for example, is known for causing laziness.

Combining, evaluating and refining

Results of the trigger-product study and practice analysis were fed into two different student design projects. The first comprised an assignment in the master course Interactive Technology Design (ITD) offered in the master program Design for Interaction at Delft University of Technology and was to:

> 'explore possible interactions with person heating devices. What could person heating devices and their interactions be like? How can they be integrated into daily activities? How will they interact with central heating systems? The device should be easily fixable and suitable in a variety of situations, to heat a variety of body parts, by a variety of different users.'

The author functioned as the client. Three student teams of four to five students worked on the assignment. They each created a working prototype of their design, which was roughly tested with a limited number of participants. The other course was the Minor Sustainable Design for bachelor level students at the same university. The assignment in this course, titled 'Exploring person heating' was very similar to the ITD one. Two groups of five students worked on the assignment for one semester. Again a design and working prototype was made, which was tested with a limited number of participants. The student projects resulted in four concepts for domestic person heating (one of the Minor projects focused on restaurants and is not taken into account here). They are the SnaP, the IGNITE, the SOE and the MANGO. Each will be briefly explained below.

SnaP (Figure 8-10) is a small blanket with integrated heating pads that can be shaped into different shapes using snap buttons. In these different shapes, one can insert hands or feet into it or place it around the neck, in the lap or behind the back. For energy supply, the product needs to be plugged into a socket. It is specifically designed for use on the couch when reading or watching television.
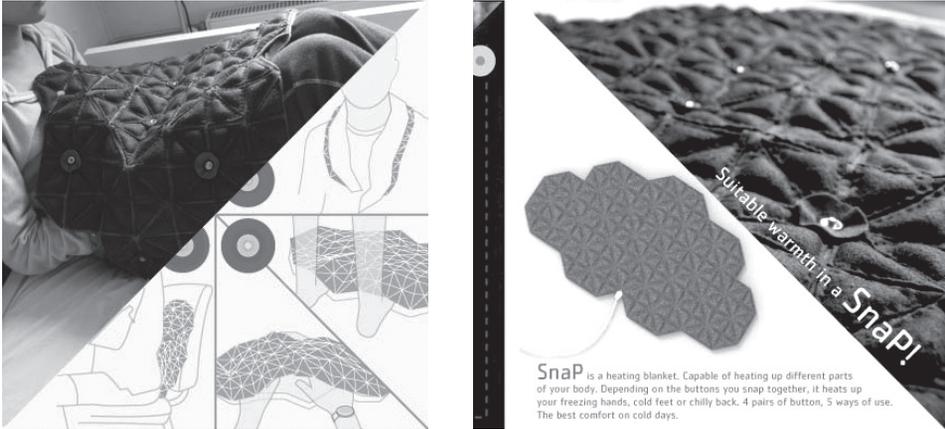
Figure 8-10 Explanatory flyer of the SNaP design (ITD WARM1).

IGNITE (Figure 8-11) is a table with hot airbags, the heat level of which can be controlled by moving a cup on the table. The hot air is provided by hair dryers. It is specifically designed for breakfast, with the idea that it eliminates the need to turn on the central heating between getting up and leaving the house.
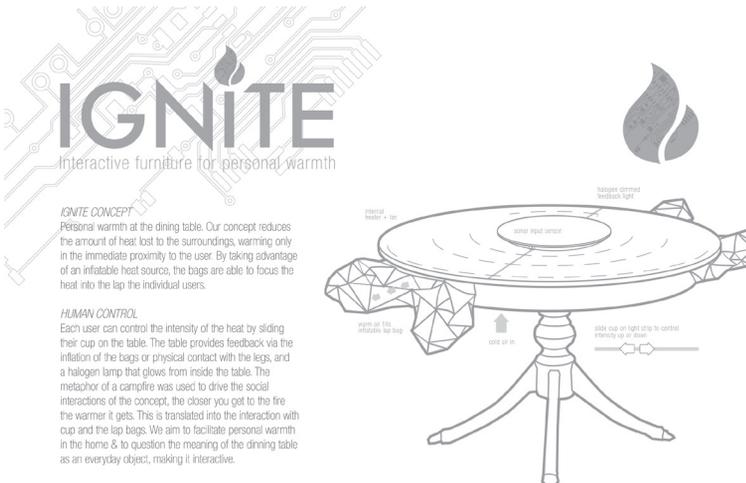
Figure 8-11 : Explanatory flyer of the IGNITE design (ITD WARM2 [7])

SOE (Figure 8-12) is a wearable personal heat source that contains integrated heat wires. It is operated with a zipper and has three heat settings. Feedback on the setting is given through different colour LEDs and vibration next to the zipper. The top layer of the

[7] The ITD WARM2 group consisted of Simon Jaspers, Mark Studer, André Taris, Sjoerd Vonk and Pauline Wout.

garment can be stretched to be pulled over the legs as in the image. Like the SnaP, it is a wire-powered product, but the wire can be disconnected from the garment so that the wearer can move around freely. When disconnected, the heating function will not work but it does work as a form of body insulation.

Figure 8-12 One of the students wearing the SOE (ITD WARM3 [8]) (picture by Guus Schonewille).

MANGO (Figure 8-13) is a heated pillow that is connected to a docking station. One docking station contains up to three pillows. The pillow can be changed in shape from a compact ball to a flat and long shape, so it can be placed on different parts of the body (the lap, the neck, the back). The design contains a timer that automatically switches off the heating elements after 45 minutes (simulating a hot water bottle), or after 5 minutes when no motion is detected.

In addition to a focus on the product and interactions between the product and their user inherent in the nature of the courses the assignment was conducted in, students thought about ways of communicating the product, about new terminology and about use instructions. As such, each design formed a proto-practice, which was more fleshed out than the one suggested to participants in the trigger-product study. Moreover, attention for interaction made sense due to the nature of the products. While space heating is something that happens very much in the background with only limited interaction, these person-heating products interact with their users relatively intensely. The products were designed to feel nice, be fun, and be cosy according to metaphors such as a campfire, a cat, a cup of tea.
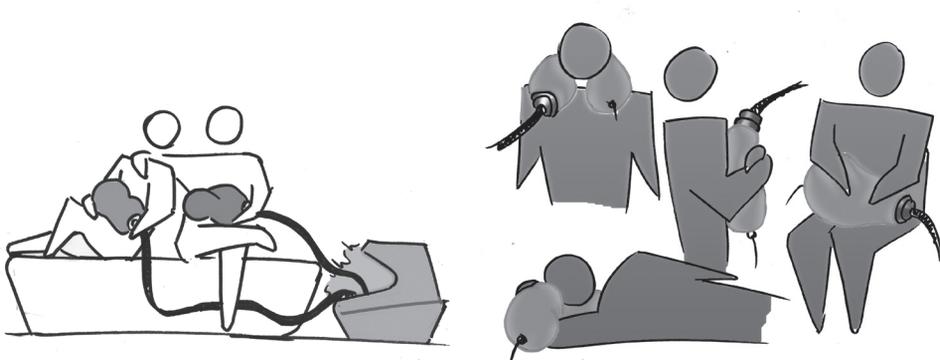

Figure 8-13 Explanatory images of the MANGO design (by Minor Sustainable Design students[9])

[8] The ITD WARM3 group consisted of Emilie van Spronsen, Ilaria Scarpellini, Melvin Zaaijer and Lynn Slooten.
[9] The Minor Sustainable Design group that made the MANGO design consisted of Nina Boorsma, Barbara Denissen, Bas Lammers and Tom van de Water.

While instructed to design for a wide variety of ways of use, students narrowed their focus to particular situations (breakfast, sitting on the couch), probably to keep the design project manageable. The IGNITE is least flexible in the different ways it can be used because it is attached to the table. However, when viewing the concept more broadly as a form of heating integrated into furniture, it becomes more widely applicable. The SOE can be worn in only one way, but it is flexible in the sense that it can easily be unplugged so the wearer is mobile beyond the length of the wire. The SnaP and MANGO are both flexible in the places of the body they can heat, but they cannot easily be carried around. The SnaP, SOE and MANGO all contain electric heating through conductive wire, the IGNITE is the only product making use of hot air to heat. In contrast to the product used in the trigger-product study, all products are wire powered. An advantage is that this reduces the likelihood of the product being taken outdoors and thus changing comfort standards there.

Brief tests with the prototypes indicate that the way in which it is currently presented induces participants to view person heating as something additional to space heating. For example, a participant liked the product and said he would use it in case his radiator would be broken. Another participant remarks that he likes the idea, but not for himself; he thinks it is something for elderly because they are always cold. Because the concepts were currently not tested in combination with a considerably lower room temperature, the proto-practice developed focuses on practices of person heating, rather than on person heating as part of the broader set of practices related to staying warm at home that include (and reconfigure) space heating. The skill of unlearning to turn up the thermostat when cold, let alone learning to change it to a lower setting – which is probably the most essential change to be made in order for the concept to succeed in terms of reductions in resource consumption – was not yet included as part of the proto-practice design. The studies did provide the valuable insight that if products for person heating are used merely as an addition to what is already there, because they use energy to operate themselves, their introduction risks leading to an increase rather than a decrease in energy consumption.

8.3.2 Concept House pilot

To develop the proto-practice further into desirable directions, one of the prototypes resulting from the student projects was used in a pilot study in the Concept House research facility in Rotterdam. The study was conducted by a master graduation student and supervised by the author. The Concept House is a so-called Living Lab facility, in the sense that it is a real-life home environment that is used for testing and developing innovations together with inhabitants (Bakker et al. 2010). As such, a Living Lab can be considered as a middle way between peoples own homes and a university lab environment.

Suggest and trigger
The pilot study involved just one participant. The proto-practice of combining space and person heating was suggested to the participant in the form of the MANGO prototype in combination with a set of instructions. These inclu ded use instructions for the product

Tijdens studeren/zitten/etc.
krijg je het koud.

Je pakt één van
de Mango's.

draait de knop bovenop
de Mango om 'warmte
binnen te laten'...

en geniet van de warmte.

Op de manier die jou bevalt.

Figure 8-14 Use instructions for the MANGO
personal heat source (Minor SD 2012).

as presented in Figure 8-14 and the assignment to keep the indoor temperature of the house at 2 to 3°C below what he was used to (which was 20°C). The prototype was used for four days. The participant had a form with questions to register experiences during the four days, and an interview was held afterwards in which the participant was asked to show the researcher what he had been doing with the prototype.

The performances

Following the instructions, the participant had set the indoor temperature of the house to 18°C. He could not set it any lower, because the house has a low temperature floor heating system that cannot be set below 18°C. Because it was fairly warm outside during the time of the experiment (15°C during the day), he also decided to dress in shorts and a t-shirt in order to feel cold. The participant was a journalist writing an article about the Concept House. This role, together with the setting of the study outside of his normal home environment is expected to have catalysed his willingness to experiment. Main issue the participant had with the MANGO product prototype was that it took 'much too long' to warm up, being 20 minutes. He used the MANGO solely on the couch, while reading, relaxing or watching television and placed it in his neck or on his belly. He enjoyed the feeling of a heater directly on his body, felt sympathy towards it and liked to snuggle with it. However, he did feel it was a bit of a hassle to use it and it would be distracting him when he would be working. Like participants in previous studies, he saw person heating as a way of getting and keeping warm in addition to existing systems of central heating, and not as a (partial) replacement (Vonk 2013).

Combining, evaluating and refining

This brief study confirms the opportunities for acceptance of person heating practices found in previous projects described above. However, the challenges of introducing such practices are also clearly highlighted, which lie in positioning it as a partial replacement of space heating. Before this positioning can be achieved, extensive reconfigurations of

practices of staying warm are required. For example, developing or finding technologies that warm up more quickly than the current prototypes (in combination with the development of skills to turn the heat source on in time, just before actually feeling too cold), learning to use the heat source in a variety of situations without experiencing it as a hassle, and learning to view person heating as an alternative to space heating and related consequences of reducing normal indoor temperatures. Additionally, the Concept House study has revealed another important challenge, as already anticipated in the analysis of current practices, which is changing the minimum temperature settings of low temperature heating systems. These changes go far beyond the realm of the product designer and members of households, towards changes in architectural design, the design of LTH systems, and likely also in building regulations and policies. Developing energy consuming personal heat sources and introducing them into the Dutch market could well be successful in the sense of creating a new market. It carries a risk however, in contributing to increased, rather than reduced household resource consumption.

8.4   Conclusions

Analysis of current practices of staying warm indicates that approaches focusing on the energy efficiency of heating systems and insulation are reaching their limits. It is even argued that the move towards increasingly optimized and standardized indoor climates is creating expectations of conditions that are independent of outdoor climate and season and thus dependent on mechanized (and energy consuming) technologies. Together with the observation that 'need for heat' is not uniform or constant but greatly varies between people and situations, and the observation that there are limits to minimizing draught, it has become clear that alternative efforts are required to reach the challenging target of 20GJ.

However, at the end of this chapter it can be concluded that although promising opportunities for desirable change were identified, efforts in these projects were (so far) not successful in generating a desirable reconfiguration that works. Practices of person heating may catch on in the Netherlands, but because the proto-practice was currently developed too much in isolation from the broader reconfiguration of practices of thermal, its introduction would now risk contributing to increases in household energy consumption rather than decreases.

While person heating in combination with a lower base temperature of around 16°C may still be integrated into a reconfiguration that works, further study is required into what such a reconfiguration would look like. First, further understanding is required of ways in which base temperatures are determined and set. Other studies for example indicate the importance of default settings in thermostats (Pierce et al. 2010), and the role of HVAC installation professionals in programming it (Wade 2012). Another role, as identified in the analysis of current Dutch practices is that of energy saving campaigns, which tend to display relatively high indoor temperatures.

Because unlike bathing practices, practices of staying warm are performed throughout the home, throughout the day (and night) and usually as part of a wide variety of other practices, such as watching television, receiving visitors or going to bed, a Living Lab

setting, rather than a university lab, seems fruitful for further developing desirable proto-practices. Moreover, the search for a reconfiguration might benefit from the involvement of other stakeholders than household members and include HVAC designers, architects, installation professionals and policy makers.

Implications of Social practice Theory for Sustainable Design

9 Conclusions

9.1 Introduction

The aim of this research has been to explore the implications of a practice theoretic orientation for sustainable design. At the start of the thesis, sustainable design has been narrowed down to the particular area of design research that is concerned with high and rising levels of resource consumption in households. Based on an overview of current approaches in this area of sustainable design and their limitations in Chapter 2, the main question has been specified to the implications of making a shift from interactions to practices as the unit of analysis and design. To address the main questions, a research through design approach was used, involving projects on the topics of bathing and staying warm at home. Based on the theoretical framework offered by theories of practice set out in Chapter 3, earlier work on practice-oriented design reviewed in Chapter 4, and insights gained from the empirical projects, a twofold practice-oriented design approach is presented in the Chapters 5 and 6. This approach forms the core result of the thesis. The empirical projects that form both the basis for and illustration of this approach are described in Chapter 7 and 8.

Having answered all sub-questions posed in Chapter 1 through the course of this thesis, the current, final chapter presents the general conclusions of the research by addressing the main research question. In addition, it will go deeper into additional contributions made by the thesis. These conclusions are followed by a discussion in which limitations of the results in the light of choices made and approaches taken are addressed. Finally, the chapter closes with an overview of avenues for future research.

9.2   General conclusions

The main research question addressed in this thesis was whether drawing on theories of practice could lead to design approaches that are more effective in addressing the issue of high and rising levels of household resource consumption than existing approaches. The answer to this question can be split into two parts. The first part is the question of whether drawing on theories of practice can lead to design approaches at all. The second part is whether these approaches can be more effective than existing approaches in addressing the issue of high and rising levels of household resource consumption. The sections below will first answer the 'approach' question affirmatively by briefly summarizing the practice-oriented approach to sustainable design proposed in this thesis. Subsequently, in Section 9.2.2 the question whether this approach can be more effective than existing, interaction-oriented approaches is addressed in terms of its added value for sustainable design.

9.2.1   A practice-oriented approach to sustainable design

Core to this thesis is the proposed practice-oriented design approach. The aim of the approach is identifying and refining opportunities for deliberate intervention that can achieve or facilitate change towards practices that have lower levels of resource consumption involved in their performance. The proposed approach, represented in Figure 9-1, works from a selected target practice, via analytic and generative steps towards a less resource intensive reconfiguration of this practice that has potential to work.

Selection of the target practice is dependent on the context of the design project, and its framing can change during the project. A practice that works is found to be repeatable after performance and has shown to be able to spread by recruiting new practitioners. It is considered desirable when its performance requires much lower levels of resource consumption than the current practice.

Below, the approach is briefly summarized. It is described from the perspective of the designer, but where it says designer this can also mean a multidisciplinary team of designers and researchers.

The analytic phase, in which practices are taken as a unit of analysis, works from a selected target practice to opportunities for intervention. The model recommends four related forms of analysis:

- **Quantifying consumption indicators**: in this step, the designer collects data on current average levels of resource consumption involved in performance of the target practice, variety on this average both within the target practice and in similar practices outside of this framing and data on the historic development of levels of resource consumption. Based on this data, and when available, studies into basic needs the designer selects a target level of reduced consumption.
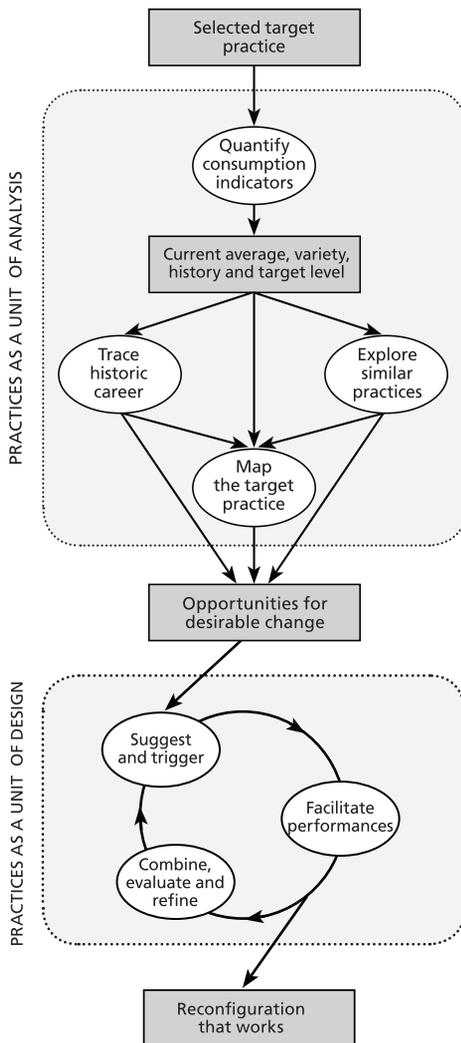
Figure 9-1 Proposed practice-oriented approach.

- **Tracing historic career**: in this step, the designer gains knowledge about the historic career of the target practice. Depending on the practice and on developments in its resource consumption identified in the previous step, it is recommended to go back at least a century or more and to use both narrative and visual representation to gain an overview. Result of this activity is insight in the stability and dynamics of the target practice and in lower resource intensive configurations of it.
- **Exploring similar practices**: in this step, the designer explores similar practices that fall outside of the framing of the target practice and have been identified as strongly lower in resource intensity. Such practices can be found in other cultures, but can also exist closer to home depending on the way the target practice is framed. Again, result of this activity is twofold, consisting of the creation of points of reference to highlight the target practice, and insight into desirable configurations that work.
- **Mapping the target practice**: in this step, the designer aims to get an overview of the target practice, with a specific focus on the relation between the constitution of the practice in terms of images, skills and stuff and its level of resource consumption. Because the designer is generally a carrier of the target practice, this step is the most challenging one of the analytic phase. Analysis of its historic career and similar practices is expected to help the designer create a critical distance. Results of the analysis are priorities for change, particularly stable characteristics of the practice and tensions in its configuration.

From these different overviews, opportunities for intervention and desirable change can be identified by combining target levels of resource consumption with elements from desirable (historic and contemporary) configurations and tensions in the target practice. The opportunities for intervention thus identified form the starting point for the generative

phase of the approach, in which practices are taken as the unit of design. This phase consists of several cycles of iterative refinement of the desirable reconfiguration. Central in the cycle are performances of the proto-practice by carriers of the target practice:

- **Suggest and trigger**: in this step, the designer prepares the proto-practice for performance. A proto-practice contains stuff (not necessarily new), skills and images, and can include novel vocabulary and suggestions on what to feel. Depending on the goals of the cycle, the designer can compose a mix of low-fidelity and high-fidelity representations of the proto-practice, and open and more specific instructions. Further triggering improvisation and experimentation can for example be done by removing elements or links from the current practice, situating performances out of everyday settings and involving people particularly skilled at improvising
- **Facilitate performances**: goal of this step is to generate a variety of reconfigurations that (have potential to) work through bodily performances of the proto-practice. Task of the designer is to recruit a variety of participants and to facilitate the possibility of repeated performances. Depending on the goals of the cycle, emphasis can be more on variety or on repetition. Important for the next step is to document performances in terms of elements, links, sequences of actions, practitioner's rationales and evaluations, and levels of resource consumption.
- **Combine, evaluate and refine**: in this step, the designer combines data of separate performances into an overview of dimensions of variety and a coherent narrative of the proto-practice(-as-entity), evaluates whether the proto-practice works or has potential to work and how and whether it has desired levels of resource consumption, and refines the proto-practice. Result of these refinements is a reconfiguration of the target practice that is expected to work and have the desired level of resource consumption and is ready to be fed back into another cycle of performances.

Eventually, the suggested reconfiguration should become ready to move from the protective environment of the incubator community that is facilitated by the designer to start leading a life of its own. It has to be noted though that because the practice continuously changes, continued monitoring of the target practice and involvement in the form of additional interventions is part of the process of practice-oriented design, which never ends.

9.2.2   Added value for sustainable design

Based on the work presented in this thesis, it can be argued that the proposed practice-oriented approach to sustainable design can be more effective in addressing issues of unsustainable levels of household resource consumption than existing interaction-oriented approaches. Briefly recalling Chapter 2, the main limitations of interaction-oriented approaches can be summarized into two main points, one being a focus on tinkering with the status quo while missing opportunities for larger scales of change, and second a risk of not achieving intended change, or even opposite effects with designed interventions. The following section will explain how the practice-oriented approach proposed here addresses these limitations. It will do so by highlighting four distinguishing characteristics of practice-oriented sustainable design, which are:

1.   Explicit attention for history and diversity in analysis of the target practice
2.   A focus on improvisation and experimentation
3.   Treating bodily performances as the locus of design activity
4.   Striving for an open design

The first two characteristics contribute to a larger scale of change, and the second two to a higher chance of achieving the desired change. For each characteristic, the section below will explain how it follows from a practice-orientation and how it contributes to the effectiveness of sustainable design. After an additional note on the potential of practice-oriented approaches to achieve large-scale reductions in resource consumption, the section will close with a brief reflection on two other limitations of interaction-oriented approaches highlighted in Chapter 2, which were a strong normative rhetoric and placing responsibility for desired change with single individuals.

1. Explicit attention for history and diversity in analysis of the target practice

Analytic activities in the practice-oriented approach explicitly involve attention to the historic career of the target practice and to diversity in its manifestations, both within and outside of the selected framing. Interaction-oriented approaches on the other hand, tend to focus on situated product-user interactions, and on average levels of consumption and ways of use. In terms of theoretical origins, the attention to history and diversity in practice-oriented design can be traced back to the idea of a practice-as-entity that exists over space and time as a recognizable, yet changing and diverse entity.

Attention to history and diversity supports an orientation towards larger scales of change in two main ways. First, it helps the designer reveal the status quo by contrasting the target practice to alternatives that have existed in the past or currently exist elsewhere. For example, analysis of practices of staying warm at home revealed a positioning of contemporary Dutch practices of staying warm at home on the space heating side of a person-heating-to-space-heating continuum. Second, by highlighting the temporality and relativity of the status quo, these forms of analysis create room for the possibility of extensive change, especially because currently existing norms, standards and needs are viewed as part of the practice and thus as varied and subject to change. For example, instead of assuming (daily) showering as a non-negotiable need, which it may seem to

be when studying the target practice alone, showering is revealed as a relatively recent and local form of bathing. Having opened the possibility for extensive change, it becomes possible to set and work towards ambitious targets for reductions of consumption levels.

2. A focus on improvisation and experimentation

Another characteristic of practice-oriented design that contributes to achieving a larger scale of change is the focus on improvisation and experimentation. It is in these particular dispersed practices that people step away from the status quo. Integral to practices of improvisation and experimentation is a justification of acting outside of the normal and of deferring judgment. Therefore, in improvisational or experimental performances, focus is on *how* alternatives could work instead of *whether* they work. This creates space for developing strongly different alternatives that may seem unacceptable at first sight. In the bathing projects for example, washing from a bucket might not seem acceptable at first, but it was developed into a proto-practice that is acceptable for at least a number of people and shows potential to become so for more. Because some practices can be relatively inert and resistant to change, practice-oriented design creates situations particularly receptive for improvisation and experimentation, thus facilitating change *of* instead of *within* the status quo. In interaction-oriented approaches on the contrary, the designer strives to make the intervention as 'smooth' as possible to make it 'fit' into existing configurations.

3. Treating performances as the locus of design activity

Practice-oriented design treats bodily performances as the locus of design activity, while the initiating designer takes the role of facilitator and catalyser. This shift of design activity to settings of daily life acknowledges that an intervention in daily life requires redesign of existing configurations that work; i.e., of the existing practice and web of practice it is part of. In terms of practice theory, this shift towards performances reflects ideas about the recursive relation between entity and performance, ideas of practices as bodily/mental routines and the idea of change as emergent. This position is basically different from the idea in interaction-oriented approaches of behaviour being predictable on the basis of causal model, which are used to make decisions about the product and thus inherently about the way it should be used and interpreted. By incorporating bodily performance in the design process and viewing interventions as starting points rather than results of design processes, practice-oriented design leads to a deeper understanding of the complex implications of an intervention on daily life. It thus allows for exploitation of desirable and partial anticipation of undesirable effects leading to a higher chance of success in achieving the desired change in practice.

4. Striving for an open design

A practice-oriented approach strives for a form of open design in which variety and change over time are facilitated by keeping open possibilities for alternative interpretations. This idea of open design directly relates to the concept of practices as changing over time and being internally differentiated. It can be contrasted to the pursuit of specific, 'good' use scenarios and optimization that is prevalent in interaction-oriented approaches. By being appropriate for a range of different performances and having some resilience to

change over time, practice-oriented design has a higher chance of achieving desired change. Moreover, these ideas of open design give body to ideas existent in philosophy of technology in the sense that they counter what Borgmann (2000) refers to as paradigmatic consumption by enhancing human engagement with 'material reality'. Along the same lines, Verbeek (2005) speaks about 'engaging products', the design of which is to him about delegations of tasks and responsibilities from things to humans (as opposed to the more common form of delegation from people to things referred to by (Latour 1992). Looking at the splash and person heating concepts, they both involve this form of delegation as compared to current alternatives of showering and central heating in the sense that both require more engagement from people than their existing counterparts do.

Larger scales of change and higher chances of success

Arguing that a practice-oriented approach is both able to achieve a larger scale of change *and* a higher chance of wide scale adoption is a bold statement that is not fully supported with evidence from the case studies, because the proto-practices could not be widely implemented within the scope of the research. Therefore, to substantiate the conclusion, a real world example is offered here that illustrates that extensive, environmentally desirable reconfiguration of everyday practices does not necessarily exclude fast and wide adoption.

This is the example of the Cool Biz campaign in Japan. About the campaign, NPR journalist Kesterbaum writes in 2007, 'two years ago, the Japanese government – essentially with the stroke of a pen – instituted a new policy that has so far trimmed more than two million tons of greenhouse gases from the country's growing emissions'. Although its introduction was quite sudden, there was more to the campaign than the stroke of a pen. Cool Biz was a well thought through and multifaceted campaign that, although not containing an explicit practice-theoretic outlook, can be viewed as the successful introduction of a radically disruptive proto-practice. The main aim of the campaign was to save energy on air conditioning in offices. It aimed high, literally, by suggesting a temperature for air conditioners of 28°C - which was for government buildings even mandatory. A setting of 28°C is not just a little higher than 'normal' temperatures (widely used models recommend temperatures between 20 and 23°C), but much higher. Yet, it succeeded, as will be argued here, because it was a well-crafted proto-practice.

Cool Biz, firstly, went beyond the idea of motivating people to change indoor temperatures. Anticipation on how a higher temperature in offices may work brought forward the importance of ways of dressing. This, and not the temperature settings, became the focus of the campaign. A proto-practice was developed involving reconfiguration of the images, skills and stuff of office fashion. Clothing designers were requested to develop 'cool' office attire, instruction sheets were made with suggestions of how to dress during summer and images of proper ways of dressing were challenged, while at the same time, new standards were promoted – importantly by government officials and captains of industry. Acting outside of the normal was further facilitated, for example with stickers saying 'Excuse my attire, I'm doing Cool Biz'. Once launched, the campaign set off a range of additional responses, such as the introduction of special Cool Biz haircuts, and the development of more Cool Biz fashion (Kesterbaum 2007). In offices, workers came up with creative ways to stay cool,

such as the use of electric or manual fans, taking laptops to cooler areas in the office and planning meetings in small conference rooms with adjustable air conditioning (Moffett 2007). And it worked. Air conditioners were turned up to higher temperatures in all government buildings. As a result, CO_2 emissions were reduced by half a million tons. In its second year, the number of companies and numbers of businessmen participating in the Cool Biz initiative expanded enormously (Kesterbaum 2007), and in 2007, the campaign had hit just about everywhere, 'with corporate offices, restaurants and even grocery stores ratcheting up the temperature' (Moffet 2007).

Even though Cool Biz is just one example, initiated from a policy rather than a product design perspective, it does show a successful case of catalysing the 'societal-level renegotiation of ideas about comfort and freshness' (Chappels 2010) and thereby achieving extensive reductions in resource consumption. Having said this, the two sections below will discuss the practice-oriented approach in the light of two other limitations of interaction-oriented approaches.

Normative rhetoric and placing responsibility with individuals

Besides limitations in achieving the desirable scale of reductions on resource consumption, interaction-oriented approaches in sustainable design are also criticized for their strong normative rhetoric of 'right' and 'wrong' behaviours, and for placing the responsibility for reducing levels of household resource consumption with individuals. The practice-oriented approach presented in this thesis is also clearly normative in the sense that it considers current European levels of household resource consumption to be too high. However, it does not prescribe particular ways of behaving. The proto-practice emerges from performances instead of being imposed on people and is acknowledged as internally differentiated and subject to change over time. It therefore offers a loose canvas that is open to a variety of interpretations. Regarding the other point of critique, it can be concluded that the approach has so far not been developed to its potential. Although focus has shifted from individuals to practices, there is still quite some emphasis on what household members and industrial product designers can do to change. Superficially taken into account so far are the roles of other stakeholders in a practice, such as policy makers, architects and installation professionals. This is therefore an area for further research.

9.2.3 Additional contributions

In addition to contributions to the particular area of sustainable design outlined above, the thesis makes several other theoretic and practical contributions. They include involving design-oriented additions to practice theory, introducing practice theory to a design research audience, and proto-practices in two areas.

Design-oriented additions to practice theory

Practice theory clearly provides a fresh view on core issues relevant to sustainable design. In this thesis, such insights were translated into a design approach. A side effect of this process of integrating a practice theoretic view into sustainable design has been insights gained from a *design-oriented view on practice theory*. Although minor and domain

specific, the thesis proposes several unique contributions to theories of practice. These are the proposed adjustment to the images-skills-stuff model as groupings of elements and multitudes of links (Figure 9-2), which helps to highlight the central relation between the practice-as-entity and the practice-as-performance. Secondly, the recursive character of this relation is further explained in another a visual, introduced in Chapter 6.
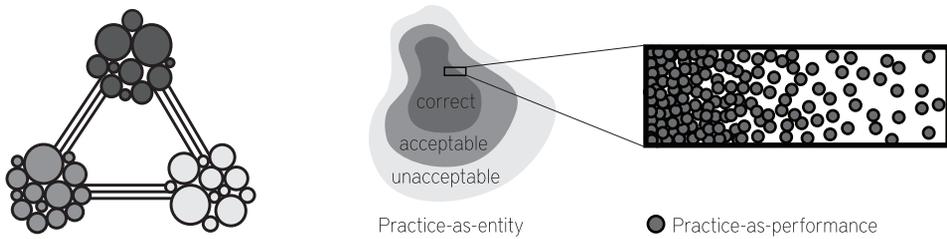

Figure 9-2 Contributions to practice theory in the form of visualisations.

Moreover, Chapter 6 develops the position of design in relation to practice theory, particularly by highlighting the importance of the dispersed practices of improvisation and experimentation for change beyond the current status quo. Such views (and the approaches that have followed from it) could be of particular interest to other areas of research that draw on practice theory and that aim for transitions towards less resource intensive ways of life, such as for example in the area of policy making. Several concrete activities in this area have been presentations of the work to non-design audiences such as at the Lancaster Sociology Summer Conference and the 4S/EASST conference. A proof of interest in these theoretic contributions has been an invitation to attend the Royal Geographers Society Annual International Conference as a guest of the Planning and Environment Research Group.

Introducing practice theory to a design research audience

Although part of the theoretic explorations of this thesis, the design oriented interpretation of theories of practice offered in Chapter 3 forms a unique contribution to design theory. During the course of this PhD project, it has become clear that convening practice theory to a design research audience is a great challenge. Practice theory is complex, it is ambiguous because of its variety of theorists, and, in many respects offers a view diametrical to mainstream (implicit) theoretical positions in design research.

The overview and interpretation of practice theory offered in this thesis has been developed over the course of four years through a series of encounters with design students and design researchers. First, there was of course its encounter with my own designerly orientation, which became particularly apparent during my stay at the Lancaster University Sociology Department. What I quickly came to realise was that this environment had a number of taboo terms that are perfectly normal in the design field. Examples are 'problem', 'solution', 'determine' and 'factor', which I gradually got used to replacing by more acceptable alternatives like 'issue' and 'intervention', or avoid altogether. At the same time, a number of new terms were added to my vocabulary, like 'nexus', 'co-evolution'

and 'transition'. It was only later, when I started to see the fundamentally different ways of approaching the world that they represented that I came to fully understand why these terms were taboo. This also made me realise that merely replacing 'problem' with 'issue' and 'behaviour' with 'practice' is not the same as adopting a practice-orientation. (It is a start though). Having experienced this process myself, the challenge became to facilitate it in other designers.

Over the course of the PhD research, ways of conveying practice theory to a design audience were developed over the course of many activities. Examples are peer-reviewed publications in design journals and conference proceedings, presentations and workshops at design conferences, informal conversations with colleagues, and the confrontation with over 150 design students through design and research projects in courses at the Faculty of Industrial Design in Delft. These encounters with students are summarized in Appendix C and will be further discussed in Section 9.2.

Proto-practices in two areas

Besides more general (prescriptive) design theory, a research through design process also results in specific design outcomes. In this case, these concern proto-practices in the areas of bathing and staying warm at home, which were coined 'splashing' and 'person heating' respectively.

Splashing is a proto-practice that has shown potential to form a much less water and energy intensive alternative to showering that works for at least part of the people having performed it. Moreover, splashing in particular has developed into an entity with a life of its own. It is now for example considered to have a history, which is described in the specific section 'History of Splashing' in one of the master theses on the topic (Henny 2013). Splashing now travels independently of the author. In certain circles, mentioning the term 'splashing' has become sufficient to describe the entire concept without further explanation. In particular design research circles, such as the SusLabNWE project, it has even become an often used example. Although splashing is currently not regularly performed by anyone, as far as known, it has come to exist as a common understanding, among design researchers and beyond. Initiatives are taken, moreover, to develop it into a form of bathing, for example through implementation in a student housing project in Gothenburg, Sweden.

The idea of person heating as an addition to space heating has not been fleshed out as much as splashing and the resulting proto-practice shows at present less potential in rendering desired effects on household resource consumption. However, the opportunity of supplementing strong reductions in indoor base temperatures with person-oriented ways of staying warm is novel in the area of sustainable design. Moreover, the idea of person heating has been materialized into a series of product prototypes that are ready to be used for further development of the proto-practice. Finally, the idea of person heating as developed in this thesis has also travelled beyond the realm of the project in the form of scientific publications, student projects, participant involvement and popular press articles.

Having summarized the unique contributions of the research to several realms of knowledge, the next section will reflect on these contributions and the approaches taken to reach them.

9.3   Practice-oriented design and practices of sustainable design

This section discusses the limitations of the proposed practice-oriented approach in the light of its own recommendations. By viewing sustainable design as a set of practices and the proposed practice-oriented design approach as a desirable proto-practice for sustainable design, the process of developing the approach can be compared to the recommended practice-oriented design process. It is a theoretical exercise, because the approach could not possibly have been used to develop itself, but as will become clear below, it is an insightful one. Viewed in its own light, the process of development, and the proposed approach itself show some important limitations. The limitations thus highlighted form a basis for further research as outlined in Section 9.4.

While approaching sustainable design as a set of practices, this section follows the same structure used to discuss the practices of bathing and staying warm at home in Chapter 7 and 8, making a distinction between an analytic and a generative phase.

9.3.1   Analysing practices of sustainable design

In the proposed practice-oriented approach, analysis starts by framing a target practice and consists of four analytic steps, being quantifying consumption indicators, tracing historic career, exploring similar practices and mapping the target practice.

The target practice for the approach developed in this thesis has been practices of sustainable design. In Chapter 1, sustainable design is framed as design research aimed at reducing levels of resource consumption in households, which is further narrowed down to interaction-oriented approaches in Chapter 2. Quantifying consumption indicators does not apply in this case, but in Chapter 1, a challenging target of reductions of over 50% is set. The core analysis process, primarily presented in Chapters 2 to 4, did briefly trace sustainable design's historic career, explored similar, more desirable practices – notably practice-oriented design, in Chapter 4 – and researched the target practice of interaction-oriented sustainable design. However, from the perspective of the proposed practice-oriented approach, this process shows a number of limitations. First, and most importantly, approaches to sustainable design were not framed as practices in their own right. Consequently, neither form of analysis has described them in terms of images, skills and stuff and their relations. Moreover, analysis of the approaches has relied primarily on descriptions in literature. Although the researcher has had personal contact with carriers of both interaction-oriented and practice-oriented forms of sustainable design on many occasions throughout the projects, they were not formally interviewed as practitioners and encounters were not systematically analysed.

Another limitation of the analysis of practices of sustainable design can be found in the fact that in terms of similar practices, only practice-oriented forms of design were fully taken into account. Other, similar forms of design, such as for example critical design (e.g. Dunne and Raby 2001), design for social innovation (e.g, Manzini and Vezzoli 2003), ludic design (e.g. Gaver 2013), and participatory art (e.g. McHardy et al. 2010) were

not taken up as points of reference or inspiration. Neither were potentially inspirational examples from the policy arena, such as backcasting (e.g. Wangel 2011), ecological modernization (e.g. Spaargaren 2011), transition management (e.g. Kemp et al. 2007), and community-led innovation (e.g. Seyfang and Smith 2007). Possibly, because of this focus on practice-oriented design as a desirable alternative, the analysis of interaction-oriented approaches has fallen in the trap of judging the practice not from its own internal logic or sense making, but from the 'external' perspective of practice-oriented design. The thesis thereby problematizes aspects of interaction-oriented sustainable design that may not be viewed as problematic by its carriers. Being critical is not a problem in itself, but this lack of understanding of the view of current carriers on the target practice does limit insight in how the practice of sustainable design could be reconfigured.

9.3.2 Reconfiguring sustainable design

Adhering to the recommendations made for the generative phase of the practice-oriented design approach, the 'proto-practice' of practice-oriented design was developed through a number of cycles in which performances of design projects were central. In total, the proposed approach, or parts of it, featured in no less than 20 different design projects. They are summarized in Appendix A. However, of these 20 projects, only one project (listed 7th in the overview) was systematically set-up and analysed as a performance of practice-oriented design. Drawing on Scott et al. (2013), results of these evaluations will briefly be addressed below. Additionally, four of the nine master graduation students were formally interviewed after their practice-oriented design projects, as were representatives of the two companies involved. These interviews form the basis for further reflection on the generation of a proto-practice of practice-oriented design.

Performing practice-oriented design in a bachelor course

Practice-oriented design was implemented in one studio of a course taught in the second year of the bachelor's programme. This course was selected because it has a long history of systemic, critical interpretations of sustainability integrated into its objectives (Boks et al. 2006). Because of the course's large size and role as a core required course in the bachelor program, the teaching of practice-oriented design had to fit the established course structures, in which students work for external commercial clients and apply a future-oriented design approach using the Vision in (Product) Design technique (Hekkert and Van Dijk 2011). The client brief for the studio involved in the study involved looking for applications for a new beverage dispensing technology, with either a manual or battery-powered variant, in the food and beverage market.

To explain the practice-oriented approach, the researcher provided students with a printed assignment, a short presentation and supplementary supervision. The printed assignment included three components:

- A short explanation of key concepts from practice theory, including Shove's 'image, skills and stuff' model, change over time and variations between different (cultural) groups. These were illustrated through a design example: an alternative system for storing vegetables called Save Food From the Fridge (Ryou 2009).

- An explanation of the relationship between concepts from practice theory and the theoretical concepts central to the course.

A step-by-step assignment guideline, instructing students to analyse the current practice, explore its historic career and compare similar practices. The steps were illustrated with examples such as 'interview your parents or grandparents about how they stored vegetables 20 to 50 years ago'.

Overall, results indicate that the practice-oriented approach did not entirely work as intended in this situation. Students performed parts of the prescribed assignment, such as collecting information on breakfast in different cultures, describing breakfast through history, visiting professional restaurant kitchens and exploring the history of food preservation. However, these inquiries were typically superficial and students found it difficult to take a distance from the current status quo. This resulted in design briefs that tended to contain an un-critical, uniform and techno-centric view of practices. There were some examples of groups identifying opportunities for more systemic change. For example, an historic inquiry on food preservation led a group to conclude that in order to retain traditional techniques for nutrient-rich food preservation, the image of preserved products needs to change. However, this notion was not reflected in their final concept: an electrical sauce dispenser for professional kitchens.

Reflecting on these results, the lack of criticality and implementation of challenging opportunities can at least partly be ascribed to the technology oriented design brief, the demanding list of deliverables, and students' excitement about presenting to a company client in which they focused on selling their ideas. On this final point, Scott et al. (2013) reflect that partnerships between industry and education, while beneficial for institutional funding and career development for students, may hinder the application of critical thinking by students. Also observed was that students tend to default to normative concepts of value in everyday practices, like ease-of-use, which can get in the way of sustainability objectives. For example, while the technology students worked with had both manually-powered and battery-powered forms, nine out of ten groups choose the battery-powered variant. This choice was motivated by pursuits of 'ease of use', 'user friendliness', speed and 'efficiency'.

What this study indicates is that practice-oriented design seems to contain a number of characteristics that are not directly compatible with existing practices in design education. However, the current setting contained a number of constraints, perhaps most importantly the highly specific, techno-centric assignment that made performance of the recommended approach particularly difficult. The following section reflects on a number of performances in the less constrained setting of master thesis projects.

Performing practice-oriented design in master thesis projects

Although not systematically analysed, implementation of the approach in several master thesis projects seems more successful in the sense that students gained depth and a critical attitude from their analysis of practices, and pursued directions that can be argued to be more radical in terms of desirable practice reconfigurations. For example, in the two food related thesis projects (5 and 12 in Appendix C) students analysed food practices largely in the way recommended in the practice-oriented design approach and identified

opportunities for change that required extensive reconfiguration. For example in the form of a shift from meat-based to vegetable based diets (Putman-Cramer 2011), or introducing more varied patterns of meat consumption by re-normalising the consumption of a wider variety of parts of animals (De Borja 2010). Additionally, quotes from interviews show how students have adopted practice-oriented dispositions towards design. For example, in the way in which Karakat (3 in Appendix C) viewed the practice of splashing as emerging from his project, in the importance he placed on detailed analysis of performances and in his view on the central role of water in bathing because 'it has been there for centuries'. Or Knupfer (13 in Appendix C), who has put great effort in making an open design, and expresses the importance of bodily performances as opposed to imagining, to judge whether a design works or not.

In spite of the large number of 'performances', however, the design projects were not explicitly and probably not to their potential used as the locus of designing the practice-oriented approach. Instead, the approach was rather unilaterally developed by the researcher. Possibly as a consequence, the approach is now presented as a particular way of handling a practice-oriented design project that could have been more open. It was not in the scope of this project to do a full analysis of this missed potential, but a birds-eye view reveals for example dimensions of variety in performances that were not incorporated in the proposed approach. Karakat used various ways to visually represent the proto-practices he selected in an early stage through mood boards and poses the idea of involving a small group of 'users' throughout the project, and Knupfer did a number of experiments with forms of splashing in his own home, placing emphasis on himself as a carrier of the practice. A quick scan of the interviews also reveals challenges encountered by the students that could have been addressed more fully to make the proto-practice work. For example, Karakat found a great challenge in documenting performances of his splash experiments to a required level of detail, mainly because they could not be observed directly. And Knupfer particularly struggled with the balance between making an open design and designing anything at all. In the end, he has not given his design a name for example because he feels that it would be too directive and 'reduce the openness the design has now'.

Finally, triggering a mode of improvisation and experimentation was in the design projects mainly achieved by introducing concepts from practice theory. Because practice theory offers an ontology basically different from dominant ontologies in design practice, it is capable of disrupting common ways of conduct. However, finding a balance between disruption and guidance still needs further experimenting. Confronting students with practice theory often left them lost, or returning to known avenues of user research and material focused 'solutions'. When succeeding in triggering a practice-orientation in design students, a next challenge was to trigger it in their clients. In a post-interview with Sealskin (the bathroom company involved in one of the splash projects) for example, the company mentor relates that he felt the splash concept proposed by Karakat deviated too much from the shower practice and to him represents a loss of comfort that only very (environmentally) motivated people might accept. For reducing water consumption in bathing, he sees more in finding ways to market products like a shower timer (that automatically turns off the shower after a pre-set time) or a system to recycle shower water for flushing the toilet. This important stakeholder in the project was not open to

the possibility of extensive change highlighted by practice theory and reverted to the 'standard' responses to reducing consumption levels based on ideas of fixed needs, individual motivations and choice, which in Chapter 2 have been criticized not to render desirable effects.

The limitations revealed by reflecting on the proposed approach in the light of its own recommendations represent opportunities for further theory development at the touching points of sustainable design and practice theory. These will be elaborated on in the next and final section of this thesis.

9.4   Future research

Practice theory and sustainable design have only fairly recently met and the two are still getting to know each other. Experiences in this research indicate that their (somewhat fractious) marriage could open up a wide range of new avenues of research, both within and outside of the area of design research. It is impossible to oversee how the relationship may develop, but from the perspective of this thesis, at least two directions for further research can be pictured. The first is based on the reflections made in Section 9.3 and entails a fresh look at sustainable design as a set of practices, and at practice-oriented design as a desirable proto-practice. The second direction builds on the observation, briefly mentioned in Section 9.2.3, that the areas of design and governance seem to have a shared concern for high and rising levels of resource consumption, and that practice theory could function as a common ground to base cooperation on.

9.4.1   Making practice-oriented design work

The proposed practice-oriented design approach was illustrated to have worked within the settings of this PhD research, meaning for the researcher and a number of design students, and within the particular empirical topics of bathing, staying warm at home and to some extent, food practices. However, whether and how it would work outside of these settings is not clear at this point. Working towards a practice-oriented design approach that works would involve taking up its own recommendations. In particular, this would involve:

- approaching and analysing sustainable design as a practice or set of practices, implying to:
  - to trace its historic career in terms of changes in configurations of images, skills and stuff
  - explore a variety of similar practices beside practice-oriented design
  - mapping current practices by studying a variety of performances in detail, revealing underlying rationales and studying its material settings
- on the basis of this analysis, identify particularly stable aspects of the practice, reveal undesirable developments and tensions while being aware of the internal logic of the practice

- consider the proposed approach as a proto-practice and develop it
  through performances, thereby paying specific attention to dimensions of
  variety and make the proposed approach more open on these dimensions

The analysis would necessarily involve the collection of empirical data, but a starting point could lie in the work of Kimbell (2009), who has studied design activity drawing on theories of practice.

9.4.2   Connecting design and governance through practice theory

Governance as a research practice involves the area of (environmental) policymaking and concerns itself with the ways in which societies organize themselves to achieve certain goals, such as sustainable consumption. Besides government, studies of governance include business, media, social movements, non-profit organisations and partnerships between them (Spaargaren 2011). Also directed at achieving desirable future situations, governance can be argued to be all about design. However, the scale at which this discipline works is quite different from the scale of product design. Practices of governance such as (urban) planning, future studies and backcasting create an image of a (possible, probable or desirable) future in the form of scenarios on the scale of a city, sector or nation, while design is focused on single products and their users, or in the case of the proposed practice-oriented approach, single household practices. This difference in scale is exactly where the two could benefit from each other. As Wangel (2012) writes, future scenarios are often 'too marco scaled, quantitative and abstract to communicate with people who are not policy makers and planners'. Introducing skills of practice-oriented design could make these scenarios more concrete and accessible for a wider audience, while at the same time, the scenarios could place proto-practices in a bigger picture of its position in a more desirable society as a whole (Ilsted and Wangel 2013).

9.4.3. Invitation to engage

This thesis has explored the implications of social practice theory for sustainable design. Although advancing understanding of the touching points of practice theory and sustainable design and of the value of their integration, the potential created by the particular outlook on design, artefacts and change offered by practice theory has far from been explored fully. Forming a basis to depart from, this thesis therefore invites other design researchers to engage with practice theory and to explore this potential further.

Summary

Implications of Social Practice Theory for Sustainable Design

The aim of this thesis is to contribute to the development of approaches for the design of durable, mass produced consumer goods that contribute to reductions in household resource consumption. This aim is based on the observation that in spite of many years of research into and implementation of various strategies for sustainable design, product development still contributes to increasing rather than decreasing levels of consumption. Because social practice theory has been identified, from several angles, as promising to inform more effective approaches, the main question addressed in the thesis is:

> Can drawing on social practice theory inform design approaches that are more effective in addressing the issue of high and rising levels of household resource consumption than existing approaches?

Because the question concerns an area of research that is still relatively immature, the thesis primarily explores what drawing on social practice theory implies for sustainable design approaches. It is more speculative towards the second part of the question concerning the effectiveness of such approaches. The question has been addressed using a research through design process, in which prescriptive design theory is developed through a series of empirical projects. Topics of the empirical projects were the resource intensive but strongly different household practices of bathing and staying warm at home.

The thesis consists of three main parts. Part I builds the theoretic foundations of the research by analysing current approaches to sustainable design in detail (Chapter 2), studying social practice theory from a design perspective (Chapter 3), and reviewing

earlier efforts to integrate social practice theory into design approaches (Chapter 4). Part II forms the core result of the thesis and describes the practice-oriented design approach that was developed, making a distinction between taking practices as a unit of analysis (Chapter 5) and taking practices as a unit of design (Chapter 6). Part III illustrates how the approach could work drawing on the two empirical projects on bathing (Chapter 7) and staying warm at home (Chapter 8) through which the proposed practice-oriented approach was developed.

Part I: Theoretical foundations

In this chapter, current approaches to sustainable design are narrowed down to interaction-oriented approaches – also referred to as 'design for sustainable behaviour'. Although containing strong points, particularly concerning their applicability in design research, education and professional practice, interaction-oriented approaches have some important limitations. They can be summarized into two main points of concern, being a focus on tinkering within the status quo while missing opportunities for larger scales of change, and a risk of not achieving intended change, or even opposite effects with designed interventions.

Social practice theory has been identified as a promising theoretical basis for more effective approaches. It offers an elaborate conceptual framework for understanding social stability and change that is fundamentally different from the (social-psychological) theories underlying interaction-oriented approaches. Most importantly, human action is in interaction-oriented approaches viewed as individual behaviour that can be explained through causal models, while in practice-oriented approaches human action is viewed as performances of practices that are governed by an entity. This entity, however, is not determining the performance. Rather, it both guides and is formed and maintained by the collective sum of its performances. In practice theory, practices are the central unit of analysis and people feature in a secondary role as carriers and performers of these practices.

Earlier explorations of the implications of this shift in theoretical basis for (sustainable) design render a different type of outcomes that lie at a larger scale of change. They also indicate that the shift implies several more and less fundamental changes to design processes and to views on the role of designers and products. Further exploration of the implications of a shift from interaction-oriented towards what has been coined practice-oriented sustainable design is required to assess its potential, which is what this thesis has set out to do. In this exploration, a distinction is made between taking practices as a unit of analysis, focusing on what currently is, and taking practices as a unit of design, focusing on what could be in the future.

Part II and III: Proposed approach and Empirical projects

The result of this exploration is a practice-oriented approach to sustainable design (depicted in Figure I) that consists of two main phases, being an analytic and generative phase. The analytic phase moves from a selected target practice to opportunities for intervention and the generative phase from these opportunities to desirable reconfigurations that work. The first part of the model recommends four related analytic activities: *quantifying consumption indicators, tracing historic career, exploring similar practices* and *mapping the target practice.* The second, generative part consists of cycles of three activities: *suggest and trigger, facilitate performances*, and *combine, evaluate and refine*. In this phase, a desirable reconfiguration, or proto-practice is increasingly refined through several iterations. Although presented in considerable detail in order to convey the full extent of knowledge gained through the research, the approach is explicitly intended to invite adjustment and further development. Below, the empirical projects are used to illustrate the process and outcomes of the proposed approach.

Analysis of the *consumption indicators* of bathing revealed a current Dutch average of 340 litres of warm water use per person per week, which is mainly used for showering. A target level of reducing this to 105 litres per week was selected based on historic developments, diversity in consumption levels and a United Nations recommended minimum. Subsequently, *tracing the historic career* of bathing from Roman times to today and *exploring similar practices* in India and Japan revealed elements that make up practices with a lower resource demand. Moreover, these explorations formed a frame of reference to *map the target practice* of showering in the Netherlands. At the end of the analytic phase, it was concluded that (close to) daily showering, with its constant flow of warm water is certainly not the only, arguably not the most effective and clearly not the least resource intensive way of bathing. The opportunity selected for further
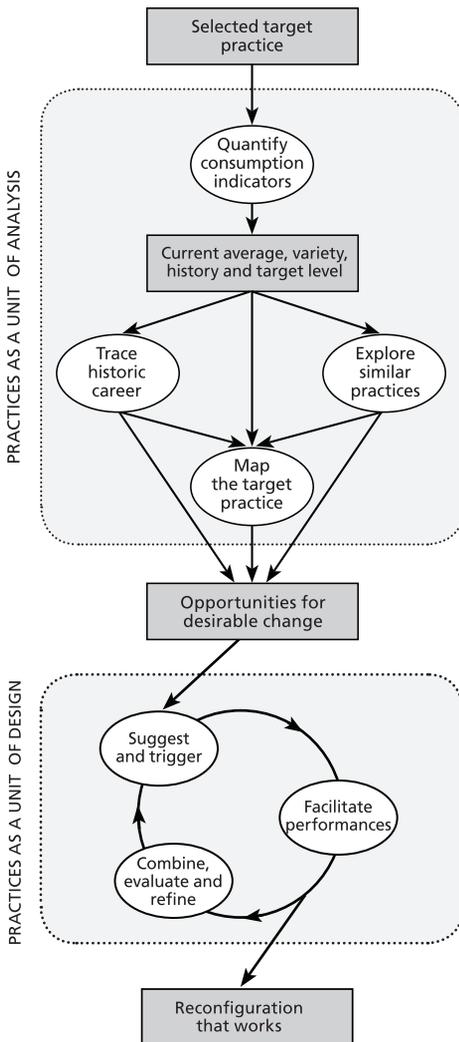
Figure I The proposed practice-oriented approach.

exploration was described as: 'a way of bathing that is based on contained rather than flowing water'. Through an iterative process in which bodily performances were central, this opportunity was fleshed out into a proto-practice coined splashing. Splashing was *suggested* to study participants in the form of a proto-practice while at the same time, participants were *triggered* to improvise and experiment in their *performances. Combing and evaluating* these performances shows that splashing has strongly lower resource requirements than showering and that it can 'work' as a form of bathing. Looking at the cases in which the practice worked for study participants, an average water consumption of 66 litres per week was measured. Further *refinement* of the proto-practice and its elements is required to enable its spread into society and longer-term studies with larger numbers of participants are recommended in order to assess its resource saving potential.

The staying warm at home projects followed a similar process, except that they were less elaborate in generating and evaluating a proto-practice. Based on current knowledge, it is not possible to assess whether the proto-practice resulting from these projects can contribute to desired reductions in household resource consumption. However, the overview of practices of staying warm at home and the identification of opportunities for design and their exploration do provide valuable insights for sustainable design. Tracing consumption indicators for domestic heating in space and time highlighted Japan as a country of inspiration. After providing an overview of shifts in Dutch practices of staying warm at home in the past century, Japanese ways of staying warm in winter were explored in more detail and revealed a diversity of ways of staying warm ranging from person-oriented to space-oriented heating and insulation. Additionally, analysis of the target practice pointed attention to the concept of base temperature as a main indicator for levels of energy consumption. Lowering this temperature is argued to be achievable by offering people possibilities for person heating in addition to space heating. While proto-practices of person heating were developed, further study is needed to flesh out their relation to space heating and base temperatures, because in their current form there is a risk of contributing to increased rather than decreased levels of consumption.

Conclusions

Having developed a practice-oriented approach to sustainable design and in parallel, outcomes such an approach could render makes it possible to reflect on the effectiveness of the approach in relation to existing, interaction-oriented approaches to sustainable design. Based on the research described in this thesis, it can be argued that the proposed practice-oriented approach can be more effective in addressing issues of high and rising household resource consumption than these existing approaches. Key to its effectiveness are four distinguishing characteristics, being:

1. Explicit attention to history and diversity in analysis of the target practice
2. A focus on extensive improvisation and experimentation
3. Treating bodily performances as the locus of design activity
4. Striving for an open design

The first two characteristics contribute to a larger scale of change, and the second two to a higher chance of achieving desired change. Explicit attention to history and diversity helps the designer to reveal the status quo, and provides insight into possible less resource intensive configurations of elements. A focus on extensive improvisation and experimentation further facilitates moving beyond the status quo towards desirable reconfigurations of existing resource intensive practices. Third, treating bodily performances as the locus of design activity contributes to the development of reconfigurations that work in the complex dynamics of everyday life and finally, striving for an open design increases the chances of such reconfigurations being and remaining appropriate for the variety of situations they end up in.

The thesis closes by identifying two specific areas for further research. First, reflecting on the process of developing the proposed practice-oriented approach in the light of its own recommendations highlights the importance of approaching sustainable design as a set of practices in its own right. Secondly, in order to look beyond the scale of product design and single practices, opportunities seem to lie at the integration of design and governance while using practice theory as a common ground. Besides these two specific directions, the thesis concludes by inviting other design researchers to engage with practice theory and further explore its potential for design research.

Samenvatting

Implicaties van de Sociale Gedragspraktijkentheorie voor het Duurzaam Ontwerpen

Doel van dit proefschrift is om bij te dragen aan de ontwikkeling van methoden voor het ontwerpen van duurzame, massa geproduceerde consumentenproducten die bijdragen aan vermindering van het grondstofverbruik door huishoudens. Deze doelstelling is gebaseerd op de observatie dat ondanks jaren van onderzoek naar en implementatie van verschillende strategieën voor duurzaam ontwerpen, productontwikkeling nog steeds bijdraagt aan de toename in plaats van de afname van consumptieniveaus. Omdat de theorie van sociale gedragspraktijken vanuit verschillende hoeken geïdentificeerd is als een veelbelovende basis voor effectievere methoden, is de hoofdvraag in dit proefschrift:

> Kan een basis in de theorie van sociale gedragspraktijken leiden tot ontwerp-methoden die effectiever zijn dan bestaande methoden in het aanpakken van de hoge en stijgende niveaus van consumptie door huishoudens?

Omdat deze vraag een onderzoeksgebied betreft dat nog relatief in de kinderschoenen staat, onderzoekt het proefschrift voornamelijk wat een basis in sociale gedragspraktijken betekent voor methoden in het duurzaam ontwerpen en in mindere mate de effectiviteit van deze methoden. Het proefschrift past een zogenaamde 'onderzoekend ontwerpen' aanpak toe, waarin voorschrijvende ontwerptheorie ontwikkelt wordt door middel van een reeks empirische projecten. Onderwerpen van de empirische projecten waren de hoog verbruikende maar sterk verschillende huishoudelijke gedragspraktijken van het wassen van het lichaam en warm blijven thuis.

Het proefschrift bestaat uit drie delen. Deel I zet de theoretische basis van het onderzoek uiteen door het in detail analyseren van huidige methoden in duurzaam ontwerpen (Hoofdstuk 2), het bestuderen van de theorie van sociale gedragspraktijken vanuit een ontwerpperspectief (Hoofdstuk 3), en het kritisch bestuderen van eerdere pogingen tot het integreren van gedragspraktijken theorie in ontwerpmethoden (Hoofdstuk 4). Deel II vorm het hoofdresultaat van het proefschrift en omschrijft de gedragspraktijken-georiënteerde ontwerpaanpak die ontwikkeld is in het onderzoek, waarbij onderscheid wordt gemaakt tussen het nemen van gedragspraktijken als een eenheid voor analyse (Hoofdstuk 5) en als een eenheid voor ontwerpen (Hoofdstuk 6). Deel III beschrijft de twee empirische projecten over het wassen van het lichaam (Hoofdstuk 7) en warm blijven in huis (Hoofdstuk 8) door middel waarvan de voorgestelde ontwerpaanpak ontwikkeld is.

Deel I: Theoretische basis

Na een kort historisch overzicht zijn huidige methoden in het duurzaam ontwerpen gereduceerd tot interactie-georiënteerde methoden – die ook wel 'design for sustainable behaviour' genoemd wordt. Hoewel deze methoden een aantal sterke punten bevatten, met name gerelateerd aan hun toepasbaarheid in ontwerponderzoek, onderwijs en de ontwerppraktijk, hebben ze ook een aantal belangrijke tekortkomingen. Deze tekortkomingen kunnen worden samengevat in twee aandachtspunten, zijnde een concentratie op kleine aanpassingen binnen de status quo waardoor kansen voor veranderingen op grotere schaal over het hoofd worden gezien, en een risico op het niet bereiken van beoogde veranderingen of zelfs tegenovergestelde effecten met ontworpen interventies.

De theorie van sociale gedragspraktijken biedt een uitgebreid conceptueel raamwerk voor het begrijpen van sociale stabiliteit en verandering die fundamenteel verschilt van de (sociaal-psychologische) theorieën die aan de basis liggen van de interactie-georiënteerde methoden. Het belangrijkste verschil is dat in interactie-georiënteerde methoden, menselijk gedrag wordt gezien als individueel gedrag dat verklaard kan worden middels causale modellen, terwijl in de gedragspraktijken theorie, menselijk gedrag wordt gezien als het opvoeren van gedragspraktijken die tegelijk fungeren als organiserende entiteit. Deze entiteit bepaalt echter niet de precieze manier van handelen. De entiteit omkadert de handeling, terwijl de entiteit op hetzelfde moment wordt gevormd en onderhouden door de collectieve som van handelingen. In de gedragspraktijkentheorie zijn gedragspraktijken de centrale eenheid van analyse en figureren mensen in een secundaire rol als uitvoerders en dragers van gedragspraktijken.

Eerder exploratief onderzoek naar de gevolgen van een verschuiving van interacties naar gedragspraktijken voor het (duurzaam) ontwerpen tonen haar potentieel voor het leiden tot uitkomsten die liggen op een grotere schaal van verandering. Dit onderzoek laat ook zien dat de verschuiving verschillende meer en minder fundamentele veranderingen in het ontwerpproces tot gevolg hebben, evenals in de manier waarop tegen de rol van ontwerpers wordt aangekeken. Verdere exploratie van de gevolgen van een verschuiving van interactie-georiënteerd richting gedragspraktijken-georiënteerd duurzaam ontwerpen

is nodig om dit potentieel te kunnen vaststellen en dit is wat dit proefschrift beoogt te doen. In de exploratie is een verschil gemaakt tussen het nemen van gedragspraktijken als een eenheid van analyse, daarbij concentrerend op wat er nu is, en het nemen van gedragspraktijken als een eenheid van ontwerpen, waarbij de focus ligt op wat zou kunnen zijn in de toekomst.

## Deel II en III: Voorgestelde aanpak en Empirische projecten
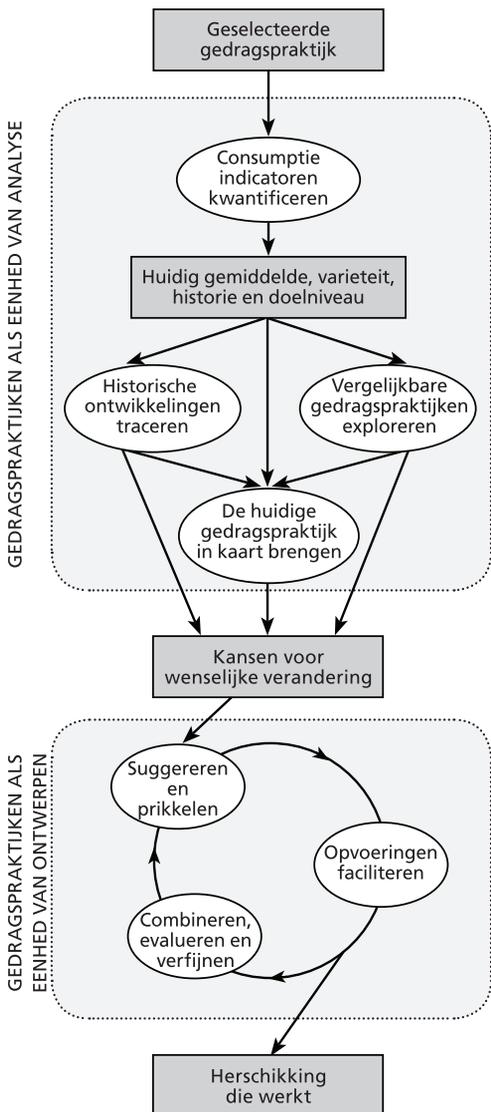
Het resultaat van dit onderzoek is een gedragspraktijken-georiënteerde methode voor duurzaam ontwerpen (weergegeven in Figuur II) die bestaat uit twee hoofdelementen, zijnde een analytisch en een generatief deel. Het analytische deel werkt van een geselecteerde gedragspraktijk naar kansen voor wenselijke verandering en het generatieve deel beweegt van deze kansen naar wenselijk herschikkingen van de gedragspraktijk die werken. Het model beveelt vier gerelateerde analytische activiteiten aan: *het kwantificeren van consumptie indicatoren*, *het traceren van de historische ontwikkelingen van de praktijk*, *het exploreren van vergelijkbare gedragspraktijken* en *het in kaart brengen van de geselecteerde gedragspraktijk*. De generatieve fase bestaat uit cycli van drie activiteiten: *suggereren en prikkelen*, *het faciliteren van handelingen*, en *combineren, evalueren en verfijnen*. In deze fase wordt een wenselijke herschikking van de gedragspraktijk, de model-gedragspraktijk, in toenemende mate verfijnd door middel van iteraties. Hieronder worden de empirische projecten besproken om het voorgestelde proces en mogelijke uitkomsten van de methode toe te lichten.

Analyse van de *consumptie indicatoren* voor het wassen van het lichaam in Nederland laat een huidig gemiddelde van 340 liter warmwaterverbruik per person per week zien, wat voornamelijk wordt gebruikt voor douchen. Het doel

Figure II De voorgestelde gedragspraktijken-georiënteerde ontwerpmethode.

om dit te reduceren tot een verbruik van 105 liters per week is gebaseerd op historische ontwikkelingen, diversiteit in consumptieniveaus in andere landen en het door de Verenigde Naties aanbevolen minimum. Vervolgens onthulde het *traceren van historische ontwikkelingen* rond het baden en douchen van de Romeinse tijd tot nu en het *exploreren van vergelijkbare gedragspraktijken* in India en Japan elementen van gedragspraktijken met een lagere verbruiksbehoefte. Bovendien vormden deze explorations een referentiekader om de *huidige gedragspraktijk in kaart te brengen*. Tegen het einde van de analytische fase kon de conclusie worden getrokken dat (vrijwel) dagelijks douchen met een continue stroom warm water zeker niet de enige, waarschijnlijk niet de meest effectieve en duidelijk niet de minst verbruikende manier van wassen is. De kans die is geselecteerd voor verdere uitwerking was 'een manier van wassen die is gebaseerd op vastgehouden in plaats van stromend water'. Via een iteratief proces waarin fysieke handelingen centraal stonden is deze kans uitgewerkt tot een zogenaamde model-gedragspraktijk die 'splashen' is genoemd. Splashen is vervolgens *gesuggereerd* aan deelnemers van studies in de vorm van een model-gedragspraktijk, waarbij deelnemers warden *geprikkeld* om te improviseren en experimenteren in hun handelingen. Het *combineren* en *evalueren* van deze handelingen laat zien dat splashen een sterk lagere verbruiksbehoefte heeft dan douchen en dat het kan 'werken' als een vorm van wassen van het lichaam. Kijkend naar de gevallen waarin de gedragspraktijk werkte voor deelnemers aan de studies is een gemiddelde van 66 liter water per week mogelijk. Verdere verfijning van de model-gedragspraktijk is nodig om haar verspreiding in de maatschappij mogelijk te maken en verder, langere termijn onderzoek met een groter aantal deelnemers wordt geadviseerd om het besparingspotentieel te controleren.

De projecten rond warm blijven thuis volgden een vergelijkbaar proces, behalve dat ze minder uitgebreid waren in het genereren en evalueren van een model-gedragspraktijk. Op basis van huidige kennis is het niet mogelijk vast te stellen of de model-gedragspraktijk voortgekomen uit deze projecten bij kan dragen aan wenselijke vermindering van grondstofverbruik in huishoudens. Echter, het overzicht van gedragspraktijken rond het warm blijven thuis en de identificatie van kansen voor ontwerpen en hun exploratie geven wel waardevolle inzichten voor duurzaam ontwerpen. Het traceren van consumptie indicatoren voor verwarming in huishoudens over de tijd en geografisch toonde Japan als een land van inspiratie. Na het geven van een overzicht van Nederlandse gedragspraktijken voor het warm blijven thuis in de afgelopen eeuw zijn Japanse manieren van warm blijven in de winter in meer detail onderzocht waaruit een diversiteit in manieren van warm blijven naar voren kwam die loopt van persoonlijke tot ruimte gerichte verwarming en isolatie. Analyse van de gedragspraktijk legde verder nadruk op het concept van basistemperatuur als een belangrijke indicator voor de hoogte van het energieverbruik. Het verlagen van deze temperatuur wordt gezien als haalbaar door het bieden van persoonlijke manieren van verwarming in aanvulling op bestaande ruimteverwarming. In de studies zijn model-gedragspraktijken ontwikkeld voor persoonlijke verwarming. Verder onderzoek is nodig naar hun relatie tot ruimteverwarming en basistemperaturen, omdat het risico bestaat dat zij in hun huidige vorm bijdragen aan een toegenomen in plaats van afgenomen energiebehoefte.

Conclusies

Na een gedragspraktijken-georiënteerde methode voor het duurzaam ontwerpen te hebben ontwikkeld en tegelijk het type uitkomsten waar zo'n methode toe zou kunnen leiden te hebben geïllustreerd wordt het mogelijk om te reflecteren op de effectiviteit van de aanpak in relatie tot bestaande, interactie-georiënteerde methoden in duurzaam ontwerpen. Gebaseerd op het onderzoek omschreven in dit proefschrift kan worden beargumenteerd dat de voorgestelde gedragspraktijken-georiënteerde methode effectiever kan zijn in het aanpakken van het probleem van hoge en stijgende grondstofverbruik door huishoudens dan bestaande methoden. Essentieel voor deze effectiviteit zijn vier onderscheidende karakteristieken, zijnde:

1. Expliciete aandacht voor geschiedenis en diversiteit in de analyse van de gedragspraktijk
2. Een focus op vergaande improvisatie en experimenteren
3. Het centraal stellen van fysieke handelingen als de spil van ontwerpactiviteit
4. Het streven naar een open ontwerp

De eerste twee karakteristieken dragen bij aan een grotere schaal van verandering en de andere twee aan een grotere kans op het bereiken van de wenselijke verandering. Expliciete aandacht voor geschiedenis en diversiteit helpen de ontwerper om de huidige status quo tevoorschijn te halen en levert tegelijk inzichten op in mogelijke, minder verbruiksintensieve configuraties van elementen. Een focus op vergaande improvisatie en experimenteren faciliteert loskomen van de status quo richting wenselijke herschikkingen van hoog verbruikende gedragspraktijken. Het behandelen van fysieke handelingen als de spil van de ontwerpactiviteit draagt bij aan de ontwikkeling van herschikkingen die werken in de complexe dynamiek van het dagelijks leven en tot slot, het streven naar een open ontwerp verhoogt de kans voor zulke herschikkingen om geschikt te zijn en te blijven voor de variëteit aan situaties waarin ze terecht komen.

Het proefschrift sluit af met de identificatie van twee specifieke richtingen voor toekomstig onderzoek. Ten eerste laat reflectie op het proces van de ontwikkeling van de voorgestelde aanpak voor gedragspraktijken-georiënteerd ontwerpen in het licht van haar eigen aanbevelingen het belang zien van het benaderen van duurzaam ontwerpen zelf als een verzameling gedragspraktijken. Ten tweede, om verder te kunnen kijken dan het niveau van productontwerpen lijken mogelijkheden te liggen op het gebied van integratie van ontwerpen en bestuur onder het gebruik van gedragspraktijken als een raakvlak. Naast deze twee specifieke richtingen eindigt het proefschrift met het uitnodigen van andere ontwerponderzoekers om zich te buigen over gedragspraktijkentheorie en haar potentieel voor ontwerponderzoek verder te exploreren.

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About the author

Lenneke (Semke Cornelia) Kuijer was born on June 28th 1981, in Heerenveen. After completing her secondary education Cum Laude at the Bornego College in Heerenveen, she enrolled in the bachelor program at the Faculty of Industrial Design Engineering of TU Delft in September 1999 with a talent scholarship. In August 2006, she obtained her master degree in Innovation Management, with an appendix on 'Technology in Sustainable Development' in the same Faculty. During her studies, Lenneke spent a total of 9 months in Japan, in 2003 as an exchange student at Kyoto University and in 2005 as an intern in the R&D centre of Toshiba in Yokohama. In 2004-2005 she participated as a delegate in the Harvard National Model United Nations, as part of a course organized by the Radboud University, Nijmegen.

After graduation, Lenneke worked as a coordinator of international student affairs for the Faculty of Industrial Design Engineering for two years, after which she started her PhD research in November 2008 at the Department of Industrial Design. The PhD was initially situated within the EU funded Living Lab project involving a design study for a Living Lab research infrastructure, in which Lenneke was an active member. After the Living Lab project was completed, Lenneke continued her research and later became informally involved in its successor project, SusLabNWE. During her PhD research, Lenneke spent three months at the Sociology Department of Lancaster University in the UK under supervision of Professor Elizabeth Shove.

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Appendixes

Appendix A: chronological overview of process in bathing studies

Master thesis Kakee Scott
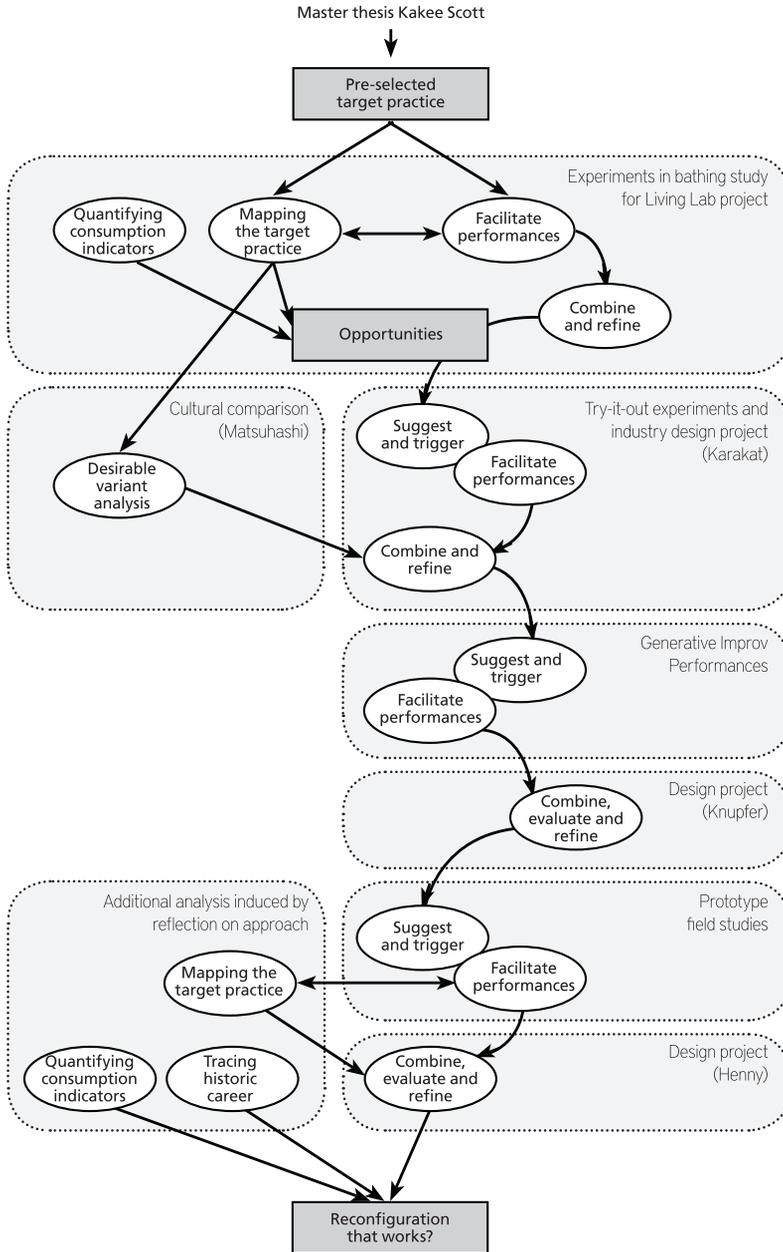
Appendix B: overview of empirical projects on bathing and staying warm at home explaining the author's role

Bathing

	Topic	Number of participants involved	Timing	Author's role
0	Ordinary Life Pilot study [Kakee Scott]	9	August-September 2008	Participant and co-analist
1	Experiments in bathing	16	November '08	Organiser and main researcher
2	Comparing the Netherlands, India and Japan [Noriko Matsuhashi]	8	February – October '09	Graduation mentor
3	Design project with bathroom company [Harish Karakat]	6	April – September '09	Graduation mentor
4	Performing splashing	17	March '11	Organiser and main researcher
5	Re-designing splash concept [Linus Knupfer]	10	April – November '11	External advisor, provider of data
6	Short term field tests and group session	10	June '12	Organiser and main researcher
7	Long term field test	5	Aug-Sep '12	Organiser and main researcher
8	Refining the splash concept [Fred Henny]	11	May '12 – Apr '13	Graduation mentor

Staying warm at home

	Topic	Number of participants involved	Timing	Author's role
1	Informal observations in Japan	4 households	Dec '09	Main researcher
2	Trigger-product study	Approximately 60 households	January + February/March '10	Design of research set-up + teacher and analyst
3	Interviews with previous generations	2 couples	July/August '10	Main researcher and interviewer
4	Architectural design project	8 households	Fall '09 – spring '10	Graduation mentor
5	Design for person heating [3 Interactive Technology Design teams]	8	Feb - Jul '12	Client
6	Design for person heating [Minor Sustainable Design]	8	Sep '12 – Jan '13	Advisor
7	Testing and refining person heating [Sjoerd Vonk]		Mar – aug '13	Graduation mentor

Appendix C: overview of 'performances' of practice-oriented design in the context of the thesis research

	Timing	Context		Use of practice-oriented design	Analysis of performances of POD
1	Nov 2008	Researcher as convener	-	Experiments in practice (bathing)	Self-reflection
2	Feb – Oct 2009	Master thesis SPD*, Matsuhashi for Living Lab	1	Exploring similar practices (bathing)	Post-interview
3	Apr – Sept 2009	Master thesis IPD* in cooperation with Sealskin and Living Lab, Karakat	1	Try-it-out experiments (bathing)	Post-interviews with student and company mentor
4	Feb-Mar 2010	Master course Observational Research	30	Trigger-product study	-
5	Apr – Aug 2010	Master thesis SPD*, De Borja	1	Analysing food practices	-
6	Nov 2010	Master course Context and Conceptualisation	28	Essay on historic analysis	-
7	Nov '10 – Jan '11	Bachelor course Design 3	20	Analysing food practices	Systematic set-up and analysis
8	Nov '10 – May '11	Master thesis architecture, De Jong	1	Dwelling design for alternative ways of staying warm	-
9	Mar 2011	Researcher as convener	-	Generative improv performances (bathing)	Self-reflection
10	Apr – Jun 2011	Master course DfI* research	20	Reflecting on research in design	-
11	Jan – Aug 2011	Master thesis, Zakkas	1	Exploring concepts of open design	-
12	Jan '11 – Mar '12	Master thesis Industrial Ecology, for Philips, Putman-Cramer	1	Combining MLP and practice-oriented design in food domain	Post-interviews with student and company mentor
13	Apr – Nov 2011	Master thesis, Knupfer for LivingGreen.org	1	Refining splash concept	Post-interview
14	Nov 2011	Master course Context and Conceptualisation	14	Essay on historic analysis	-
15	Apr – Jun 2012	Master course Interactive Technology Design	15	Refining concepts of person heating	-
16	Apr – Jun 2012	Master course DfI* research	20	Reflecting on research in design	-

	Timing	Context		Use of practice-oriented design	Analysis of performances of POD
17	Sep '12 – Jan '13	Bachelor Minor Sustainable Design	10	Refining concepts of person heating	-
18	Jun – Sep 2012	Researcher as convener	-	Prototype field studies (bathing)	Self-reflection
19	Apr '12 – May '13	Master thesis IPD*, Henny, for SusLabNWE	1	Refining splash concept	-
20	Mar – Aug 2013	Master thesis DfI*, Vonk, for SusLabNWE	1	Refining person heating concepts	-

* IPD = Integrated product design, SPD = Strategic Product Design,
DfI = Design for Interaction

Sustainable design faces challenges at a scale and level of complexity that are ill at ease with design's mainstream focus on products and users. Recently, social practice theory has been suggested as a promising theoretical framework to inform new ways of designing. In social practice theory, practices – socially shared entities such as cleaning, cooking and playing - are taken as the fundamental unit of analysis. So far, however, design research in this area has been scattered and varying strongly in its interpretations of the implications of a 'practice-orientation'. This thesis explores these implications through a series of empirical projects on the topics of bathing and staying warm at home and introduces a coherent practice-oriented approach to sustainable design.

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