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

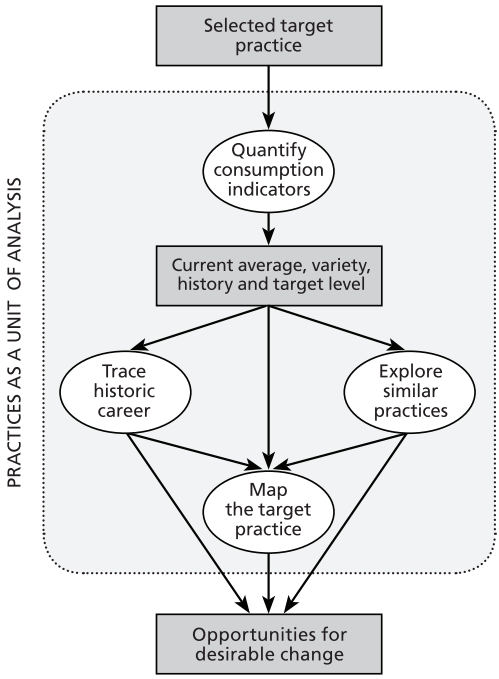

Figure 7-1 Model for the identification of opportunities for intervention in a selected target practice (circles represent activities, squares intermediate results).

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.

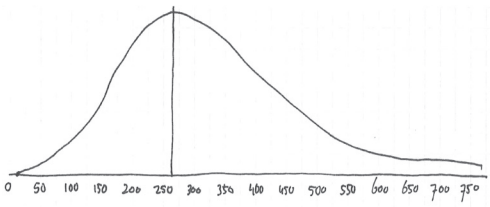

Figure 7-2 Estimated distribution of water consumption for showering in the Netherlands per person per week (median approximately 270 litres, average 340 litres).

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.

[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.

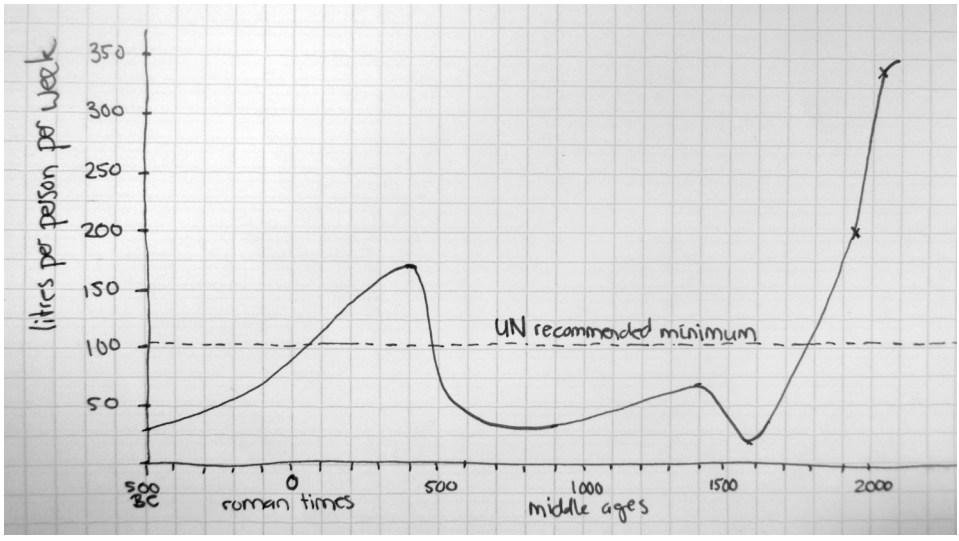

Figure 7-3 Estimated water use per person per day [convert to weekly] for bathing (500BC to present).

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 CO2 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.

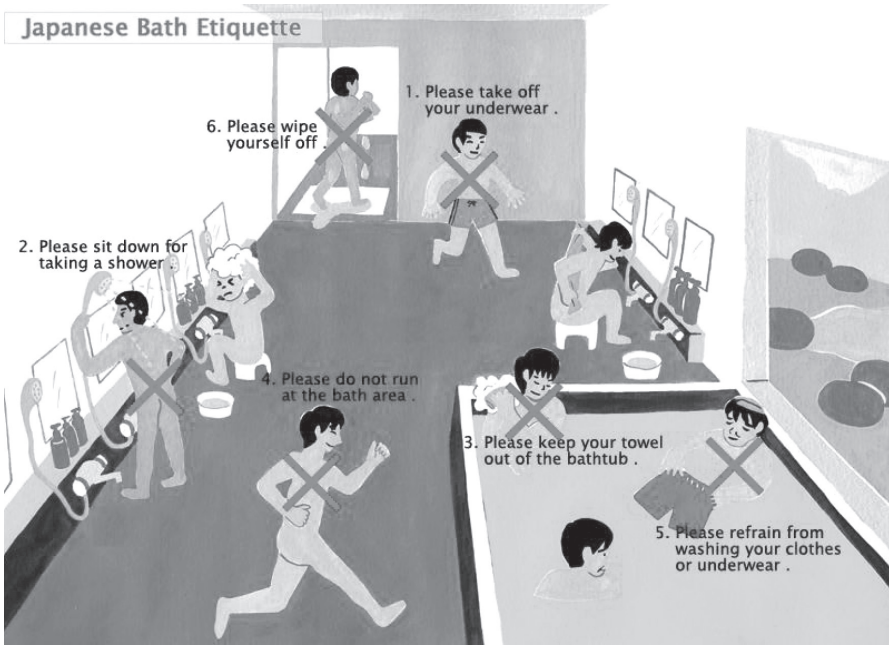

Figure 7-5 Instructions on how to bath in Japan (Image: travel-japan.jp).

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.

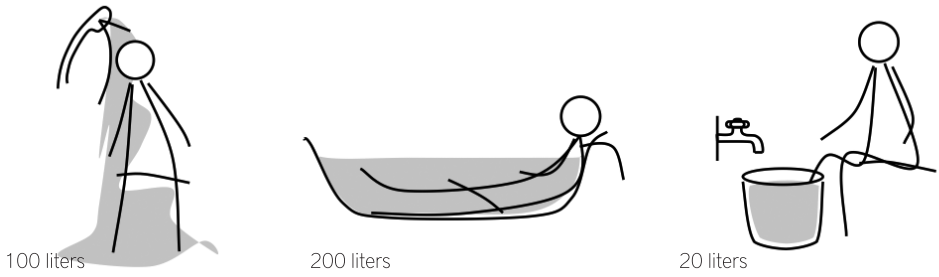

Figure 7-8 Three bathing styles and their average water requirements (Matsuhashi et al. 2009).

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

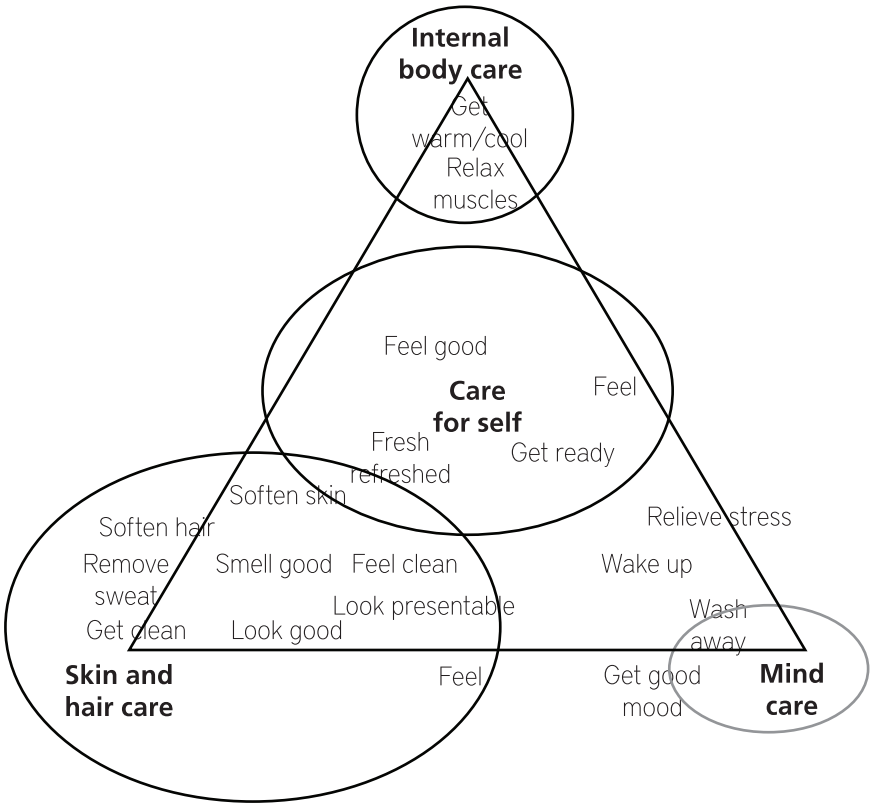

Figure 7-9 Grouping of image aspects of bathing as a practice as mentioned by the participants in the experiments in practice study (size of circles corresponds with frequency of aspects mentioned) (Kuijer and de Jong 2010).

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.

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

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

'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

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

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.

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.

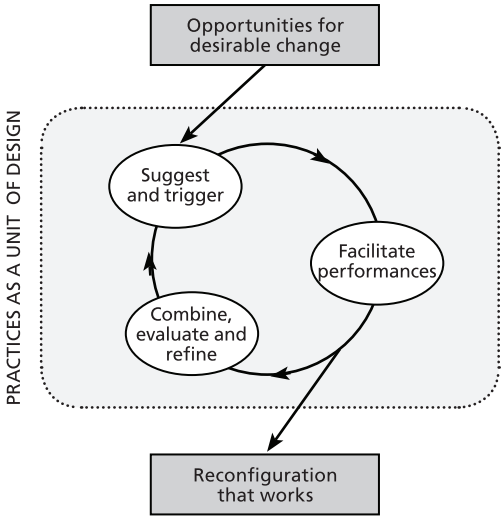

Figure 7-12 From opportunities for intervention to reconfigurations that work; practices as a unit of design.

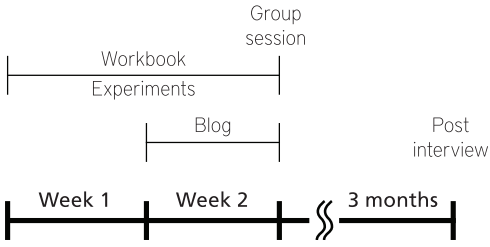

Figure 7-13 Set-up of experiments in practice study (Kuijer and de Jong 2010).

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) • Replace all showers with washing from bucket while squatting (bucket, cup, washcloth)
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

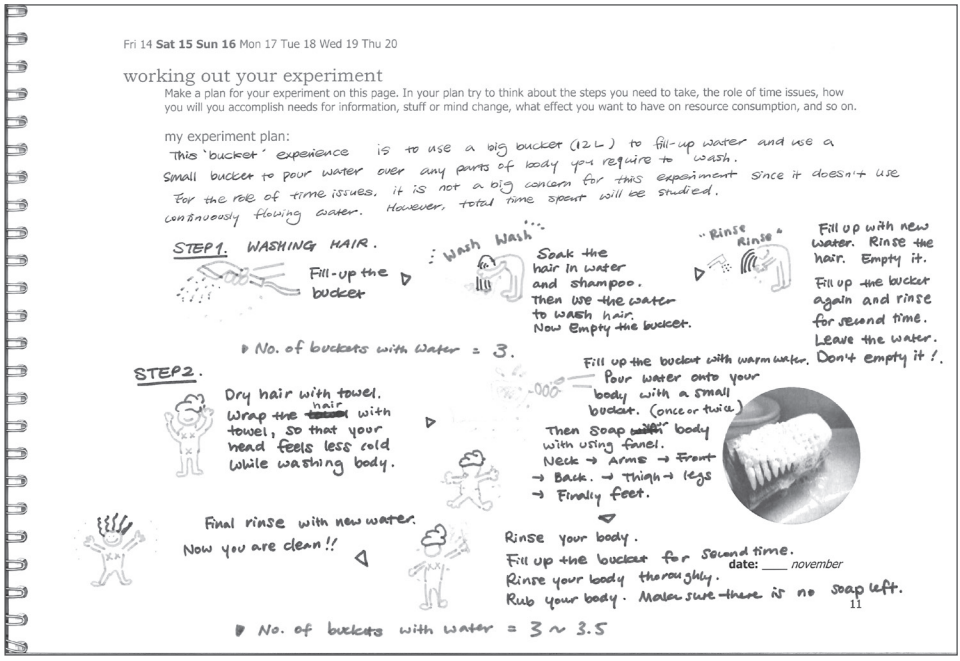

Figure 7-14 Description of bucket wash experiment by one of the participants in her workbook.

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.

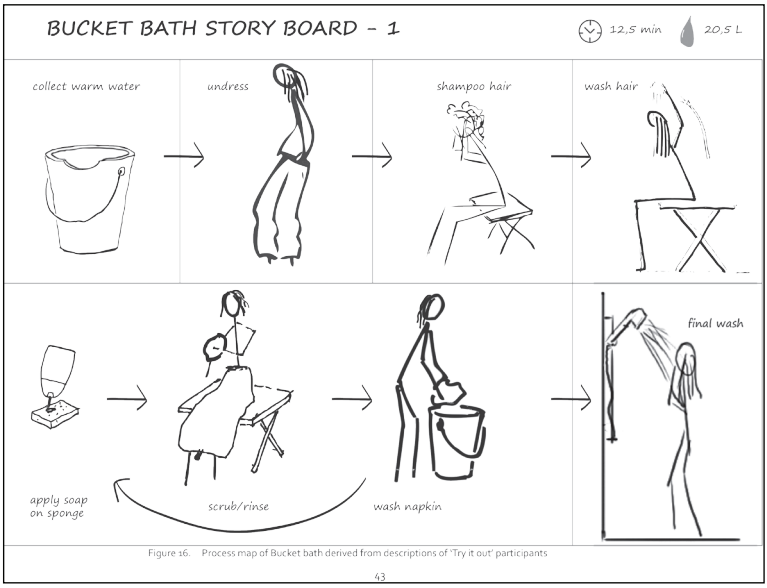

Figure 7-16 Process map of bucket bath derived from descriptions of performances by participants (Karakat 2009: 43).

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.

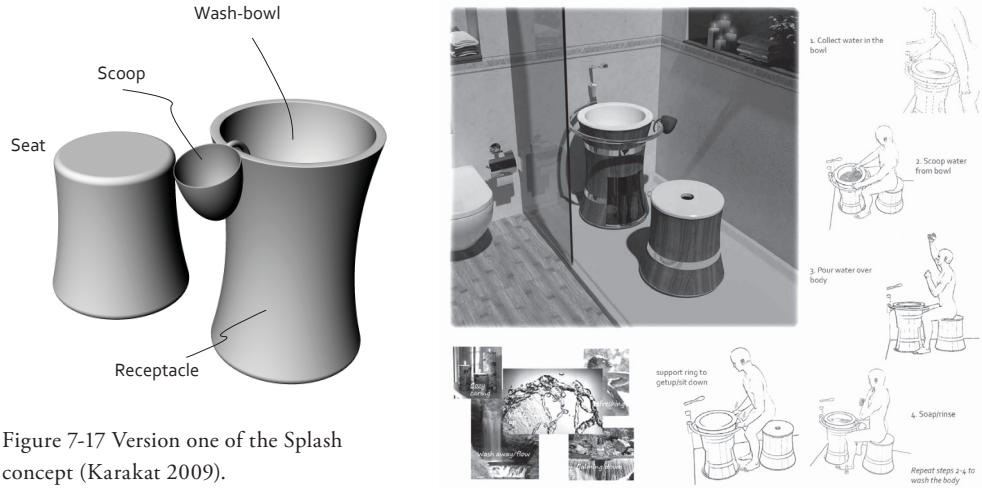

Figure 7-17 Version one of the Splash concept (Karakat 2009).

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).

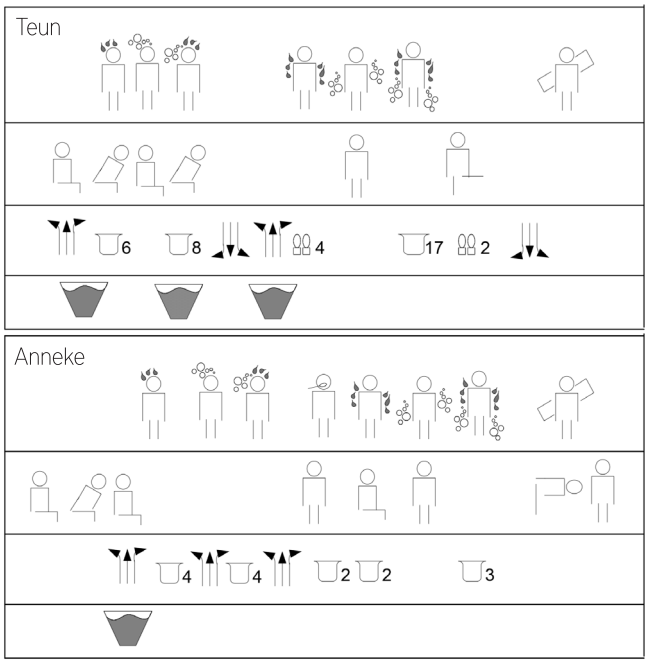

Figure 7-20 Graphical overviews of the performances of Teun (top) and Anneke (Kuijer et al. 2013).

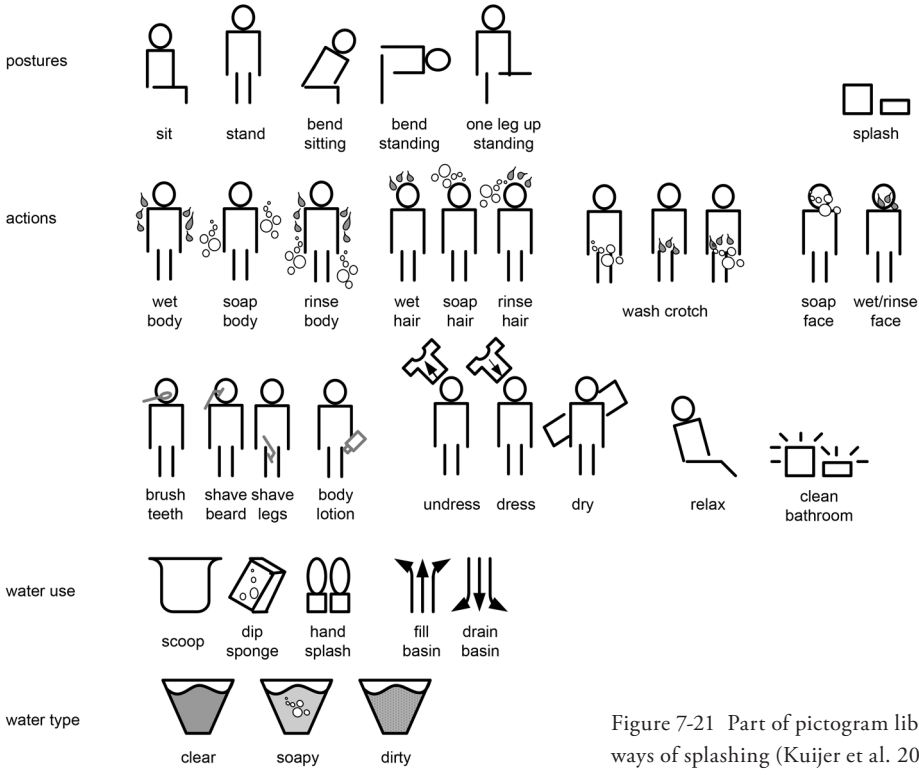

Figure 7-21 Part of pictogram library of ways of splashing (Kuijer et al. 2013).

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.

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

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

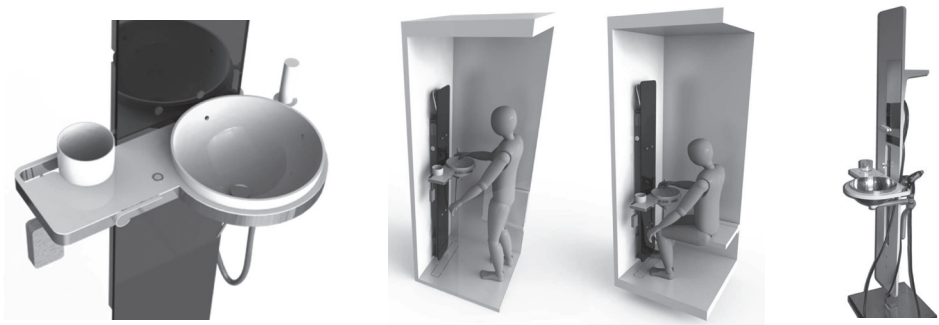

Figure 7-23 Design by Linus Knupfer for LivingGreen project (Knupfer 2011).

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.

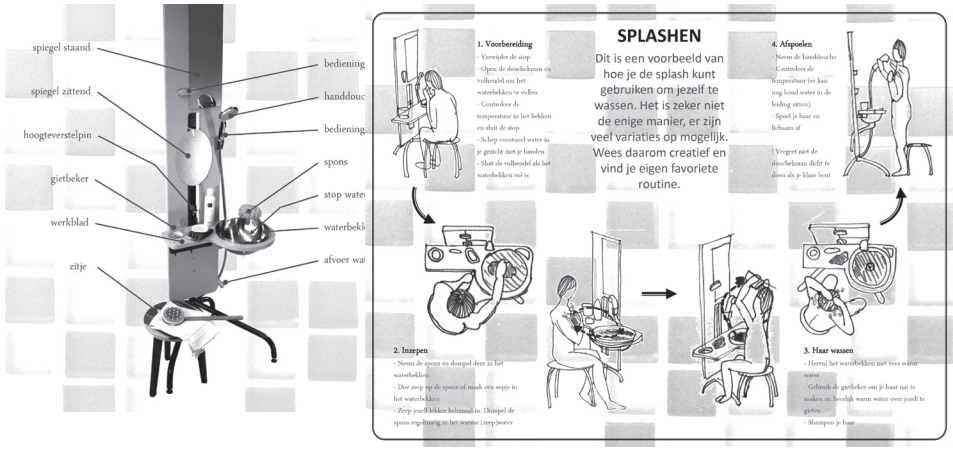

Figure 7-24 Names of parts and use instructions for splashing.

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.

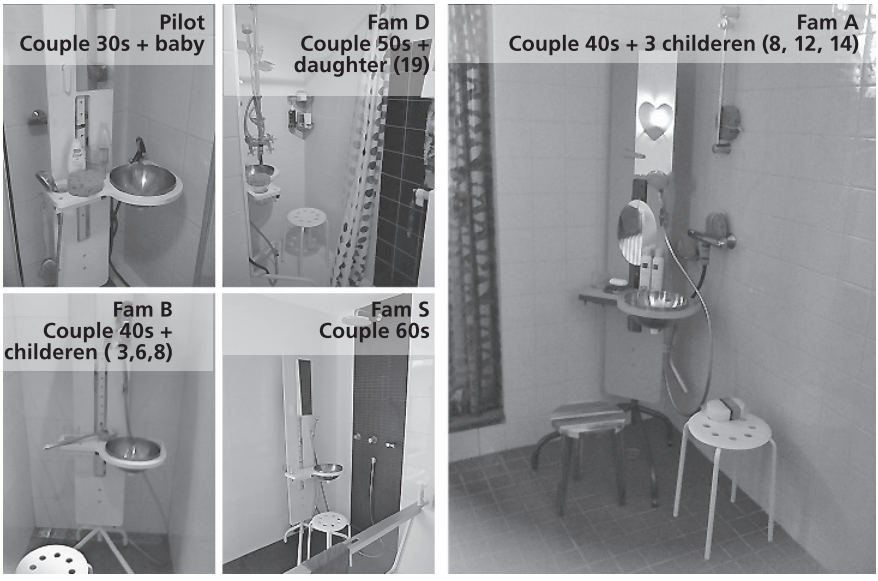

Figure 7-25 Visual impression of installed splash prototype in the participating households.

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.

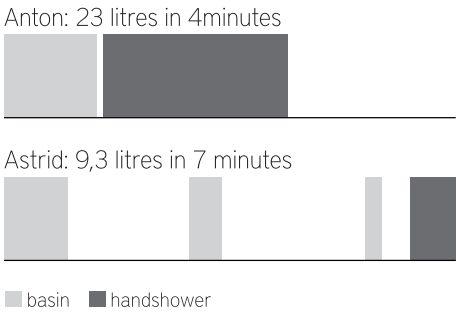

Figure 7-26 Water use patterns of two family members in the second field study.

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).

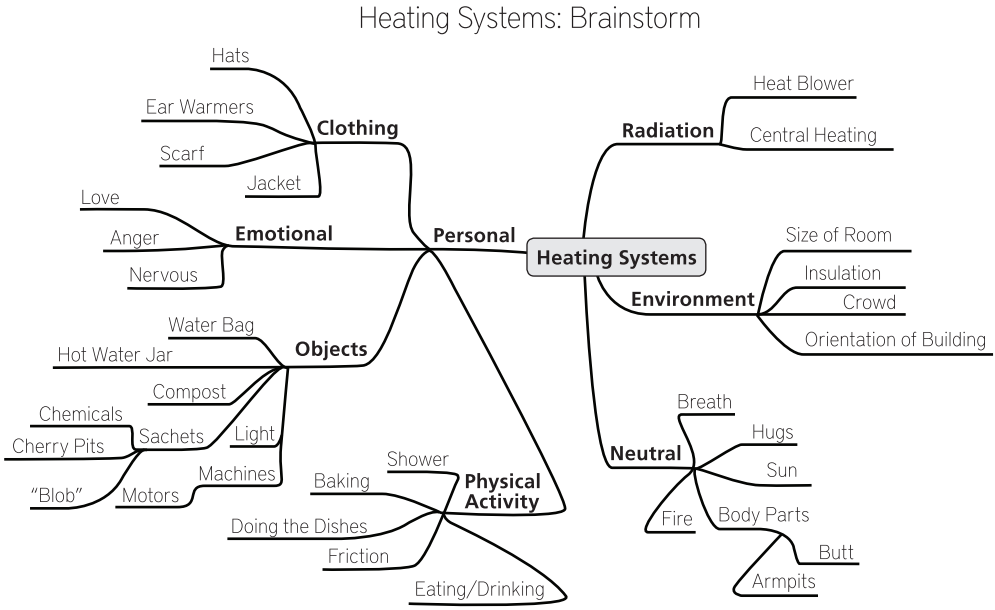

Figure 8-1 Different ways of heating the body (graphic by ITD WARM1 [6]).

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

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

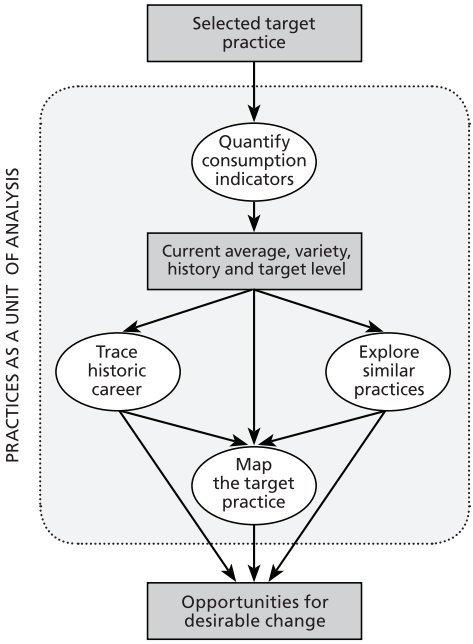

Figure 8-2 Model for taking practices as a unit of analysis and identify opportunities for intervention in a selected target practice (circles represent activities, squares intermediate results).

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

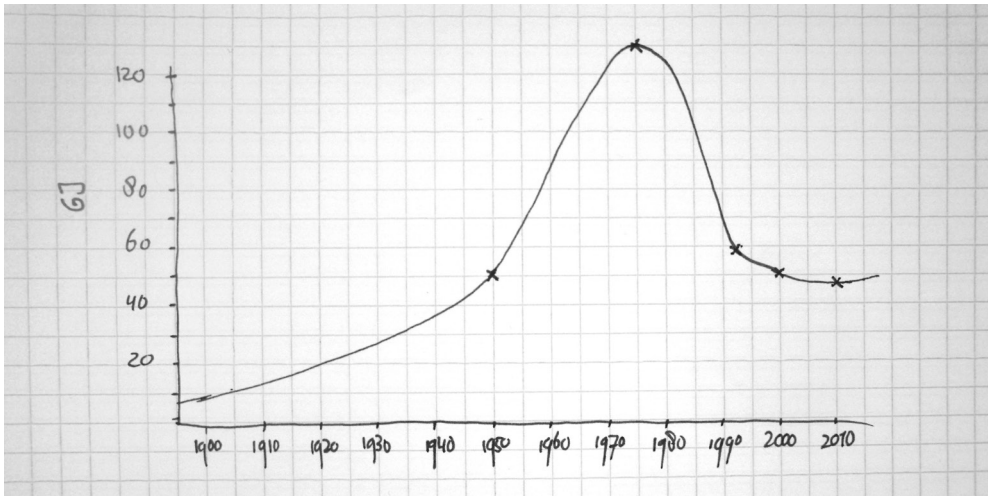

Figure 8-3 Historic energy demand for domestic heating in the Netherlands (including water heating) (Overbeeke 2001, Van der Wal and Noorman 1998) [replace with per person figure].

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).

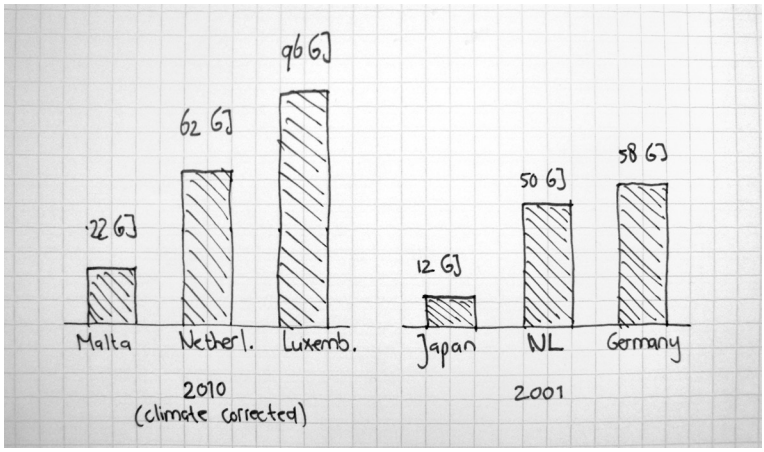

Figure 8-4 Visualising ranges of variety in energy demand for heating of dwellings per year.

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.

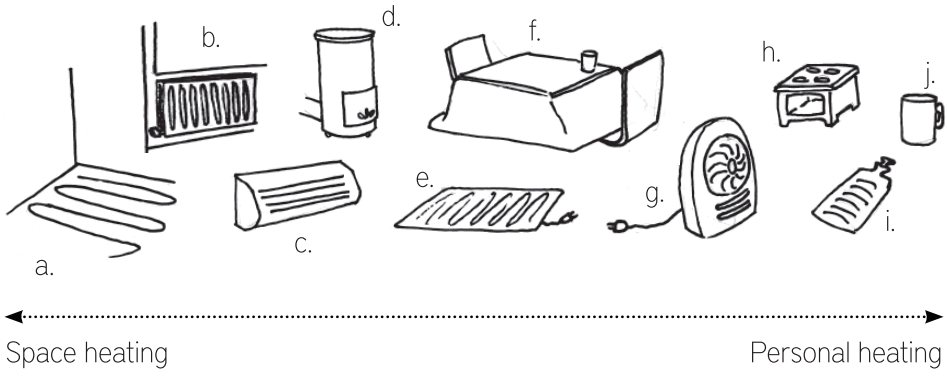

Figure 8-7 Forms of heating on a scale from space heating to person heating (a. floor heating, b. radiator, c. air conditioner, d. gas stove, e. electric carpet, f. 'kotatsu', g. portable heater, h. 'stoof', i. hot water bottle, j. hot tea) (Kuijer and De Jong 2012).

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

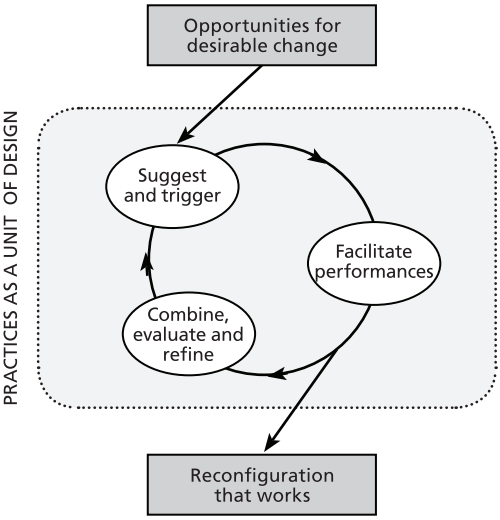

Figure 8-8 From opportunities for intervention to reconfigurations that work; practices as a unit of design.

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.

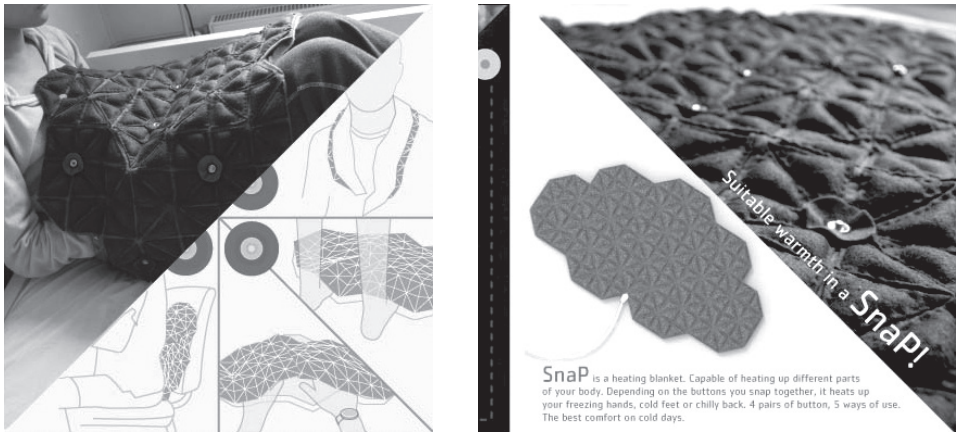

Figure 8-10 Explanatory flyer of the SNaP design (ITD WARM1).

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.

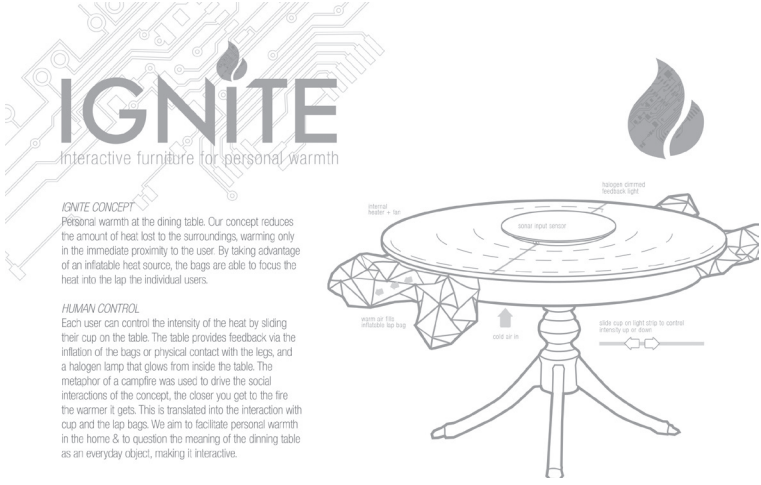

Figure 8-11 : Explanatory flyer of the IGNITE design (ITD WARM2 [7])

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.

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

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.

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.

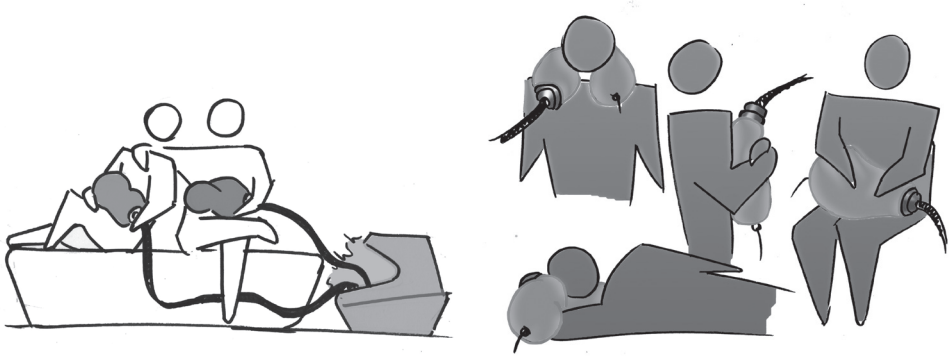

Figure 8-13 Explanatory images of the MANGO design (by Minor Sustainable Design students[9])

[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

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.