Pleasurable Ways of Staying Warm

– A Pathway towards Reduced Energy Consumption

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Hedonic consequences of pro-environmental behaviour can constitute an important barrier to behaviour change. Subsequently, hedonic aspects of heating and hot water use must be understood to be able to consider possible hedonic consequences when promoting less energy demanding ways of staying warm. Two user studies were performed aimed at exploring what types of hedonic pleasures that are elicited through use of hot water and heating systems, additional heating artefacts, and in different types of thermal situations. It was found that physical and emotional pleasures are present in everyday use of heating and hot water systems and in use of additional heating artefacts. With the identified hedonic experiences as a basis, there is an opportunity to design new heating artefacts that are pleasurable to use in a pro-environmental manner.

Key words: design for sustainable behaviour, emotions, pleasurable products, thermal comfort

1. Introduction

In daily life, we use energy in many different ways, but we are often unaware of the extent of our consumption due to the invisibility of energy in modern homes. Nevertheless, the consumption is present in other ways, e.g. in thermal experiences such as the sensations of hot baths and showers, of bare feet on heated ceramic floor tiles, and in large constantly heated living spaces [2]. Despite its invisibility, the energy used for space heating and hot water in homes contributes significantly to society's total energy consumption and thus constitutes a challenge for future sustainable energy systems. In Sweden, as an example of a country with a cold climate, the consumption of heating and hot water constitute almost 60% of the total energy use in the residential and commercial sector [6] and contributes to peaks in power demand.

Thermal comfort has often been seen as universally definable optimal indoor conditions but, following Chappels and Shove's [4] arguing, it should rather be seen as a socio-cultural construct, where the diversity of people's expectations on thermal comfort could be explored. This idea is supported by Gram-Hanssen [7]. She found in an interview study on heat consumption with 30 households in identical houses in Denmark that there are great variations in expectations of comfort, in comfort practices and in knowledge, resulting in three times higher thermal energy consumption in high consumption households than in those of low consumption. Additionally, people's expectations of comfort have changed during the last decades and the same indoor conditions are now expected everywhere [4]. In Swedish homes e.g. there has been an increase of the indoor temperature due to inexpensive energy, more sedentary activities in homes, and changed habits of clothing. Furthermore, residents in Swedish flats are generally not engaged in lessening their consumption of heating and hot water, rarely know

whether or not they can regulate their heating, and seldom relate their behaviours to energy saving [3]. This might be related to the circumstance that in the majority of flats in Sweden, unlike many other countries, a standardised cost for heating and hot water is included in the rent. As a result, the owners of such buildings have much to gain from low consumption while the residents have no way of learning about their consumption and lack economic incentives to conserve.

The importance of people's heating and hot water practices on energy consumption in combination with the lack of engagement in conservation among Swedish residents in flats constitutes the background for an on-going research project. The purpose of the research project is to investigate how to encourage people to engage in less resource demanding ways of staying warm. The studies presented herein are a part of this research project.

1.1 Goal-framing theory

Goal-framing theory [17] offers a useful framework to understand why or why not people engage in conservation of heating and hot water or in other pro-environmental behaviours, i.e. behaviour that harms the environment as little as possible [23]. According to the theory, people have three high-order goals that, when active, steer what knowledge and attitude structures that will be accessible as well as how behavioural alternatives will be perceived and evaluated. In short, it can be said that an active goal frames the whole situation. The non-active goals will be subordinated and either weaken or strengthen the focal goal, depending on the active goal's compatibility with the background goals. The goals, or goal-frames, are: (i) hedonic "to feel better right now"; (ii) gain "to act guard and improve one's resources"; and (iii) normative "to act appropriately" [17]. The hedonic goal focuses on pleasure and excitement while evading effort and negative emotions. In the hedonic goal-frame, people are sensitive to events that decrease their pleasure or affect their mood negatively. The gain goal-frame makes people seek improvements of personal resources or prevention of decrease in resources. The resources can be of different kinds e.g. economical or social, the latter in terms of positive or negative sanctions from others. In the normative goal-frame people are sensitive to what themselves and others think one ought to do and what others actually are doing. Therefore, one might e.g. recycle household waste just because it is the right thing to do. The hedonic goal frame relates to satisfaction of basic human needs and it is therefore presumed to be the strongest; nevertheless it is the least investigated of the three in relation to pro-environmental behaviour [17]. Instead, pro-environmental behaviour is often linked to the normative goal-frame as people are assumed to think that pro-environmental behaviour is the appropriate thing to do or that others find it important. The gain goal-frame has been applied in cases where economic gains can be achieved e.g. in home energy feedback systems.

Barbopoulos [1] expanded the three high-order goals in the goal-framing theory into seven sub-goals, as can be seen in Table 1. Based on these sub-goals a measure of determinants of consumption was developed, called the Consumer Motivation Scale. The evaluation of the scale gave empirical support for the connection between a certain goal-frame and information seeking related to the goal [1].

Table 1. The three high-order goals in goal-framing theory and seven related sub-goals [1]

Goal	Sub-goal	Motive
Gain	Value for money	To get value for money, pay a reasonable price, avoid wasting money
Gain	Quality	To get something of high quality and reliability, meeting one's highest expectations
Hedonic	Stimulation	To get something exciting, stimulating or unique, avoiding dullness

Hedonic	Convenience	To get something pleasant and comfortable, avoiding hassle and discomfort
Normative	Social Acceptance	To make a good impression, identifying with peers, conforming to expectations
Normative	Ethics	To act according to moral principles and obligations, avoiding guilt
(Gain and Hedonic)	Safety	To feel safe, calm and prepared for the unforeseen

Following goal-framing theory, there are two ways to promote pro-environmental behaviour: either to strengthen the normative goal-frame or to make the hedonic and gain goal-frames more compatible with the normative goal-frame [17]. Steg et al. [22] found that people with strong hedonic values are more likely than others to consider possible hedonic consequences of a choice and are less likely to lessen comfort and pleasure to reduce their consumption of energy. Therefore, they suggested that hedonic consequences of pro-environmental behaviour constitute an important barrier to behaviour change. Thus, interventions intended to encourage pro-environmental behaviour must consider possible deterioration in hedonic experiences.

1.2 Aim

Hedonic experiences in the area of heating and hot water are clearly connected to physical comfort and discomfort and pleasurable physical experiences. But previous findings suggest that warmth and thermal experiences are related to emotional reactions as well [9-12, 25] and that dynamic changes in thermal temperature have the potential to be satisfactory [19]. The authors therefore presumed that use of heating and hot water is strongly influenced by the hedonic goal-frame. Subsequently, hedonic aspects of heating and hot water use must be understood to be able to consider possible hedonic consequences when promoting less energy demanding ways of staying warm.

Two studies were conducted to investigate hedonic aspects of heating and hot water use. The first study aimed at identifying what emotional reactions that are elicited in different thermal situations and how people evaluate these situations. The second study aimed at identifying hedonic aspects in people's current ways of maintaining thermal comfort.

2. Method

2.1 Study I: When are you cold?

The first study consisted of a questionnaire and a diary. The study was kicked-off by a meeting at the university in which the participants filled in the questionnaire and the diaries were introduced and distributed. The participants returned the diaries after one week via mail. Seven kick-off meetings were held with two to eleven participants in each. In total, 35 people participated, 21 men and 14 women. The mean age was 40 years. 19 participants were recruited through ads in the local newspaper, libraries and super markets, 14 participants were recruited through e-mails to university students and employees, and five participants were recruited through posts in social media. The study had a wider scope than what is of interest for this paper and only parts of the study could be presented herein.

Thermal situation questionnaire

The questionnaires investigated what emotional reactions that are elicited in different thermal situations and what evaluation words that best describe the characteristics of the situations. The participants were shown

photographs of people in six different thermal situations, ranging from cold to warm, together with a short written description of the thermal situation depictured, see Figure 1. Thereafter the participants were asked to rate the thermal situations on a standardised instrument.

Figure 1. The photographs of thermal situations used in the questionnaire

The instrument was developed by Hesselgren [8] and consists of five sets of statements with multiple choices to each statement, as in Likert scales. In this study, a six-point scale was used, ranging from "strongly disagree" to "strongly agree". From the original five sets of statements, one set with emotions and one set with evaluation words were used. Hesselgren based the set with emotions on Plutchnik's [20] basic emotions. More recent instruments for measuring emotions have been developed, e.g. ProEmo by Desmet [5]. Nevertheless, Hesselgren's instrument was chosen because it is written and tested in Swedish, the native language for most participants in the study, and because it has been evaluated with photographs of architectural environments, an application considered to be similar to the photographs of thermal situations. In the set of statements with evaluation words, not all words were thought to be applicable to thermal situations. Those were either rephrased or substituted with evaluation words inspired by product relevant emotions defined by Desmet [5] or with words specifically applicable in this case based on findings from Gram-Hanssen's interview study [7]. The two sets of statements are presented in Table 2.

Table 2. The statements with emotions and evaluation words in the thermal situation questionnaire

The thermal situation in the photograph elicit in me: …… (emotion)		The thermal situation in the photograph is, according to me: …… (evaluation word)		
Emotions (Plutchik's English words [20])	*Hesselgren's Swedish words [8]*	Evaluation words	*The words' sources*	*Swedish words*
Anger	*Vrede*	Cosy	*Gram-Hanssen [7]*	*Mysig*
Joy	*Glädje*	Pleasant	*Hasselgren [8]*	*Behaglig*
Acceptance	*Gillande*	Fascinating	*Desmet [5]*	*Fascinerande*
Surprise	*Överraskning*	Unpleasant	*Rephrased from Hasselgren [8]*	*Otrevlig*
Fear	*Fruktan*	Boring	*Hesselgren [8]*	*Tråkig*
Sadness	*Sorg*	Secure/safe	*Hasselgren [8]*	*Trygg*

Disgust	*Avsky*	Funny	*Hasselgren [8]*	*Rolig*
Anticipation	*Förväntan*	Dangerous	*Rephrased from Hesselgren [8]*	*Farlig*

Thermal diary

The diaries explored what people do when they are cold or warm. In addition, the diaries shed light on when and where this happens and which body parts are affected. Diaries are annotated chronicle records kept by the participants and can be used when observational research is difficult to carry out [26] and have been used in many different types of studies. The layout of diaries can vary in complexity from free text to questionnaire-like formats and from quantitative to qualitative data, or a mixture [24]. For this study, a paper diary was developed that combined check boxes and free text questions. The participants were asked to fill in the diary whenever they were cold or warm during one week in February or March 2012. On each such event the participants noted which body parts that were affected on an outlined of a body, when and where the event took place, what they were doing, and if they took action to dissolve the thermal discomfort, see Figure 2.

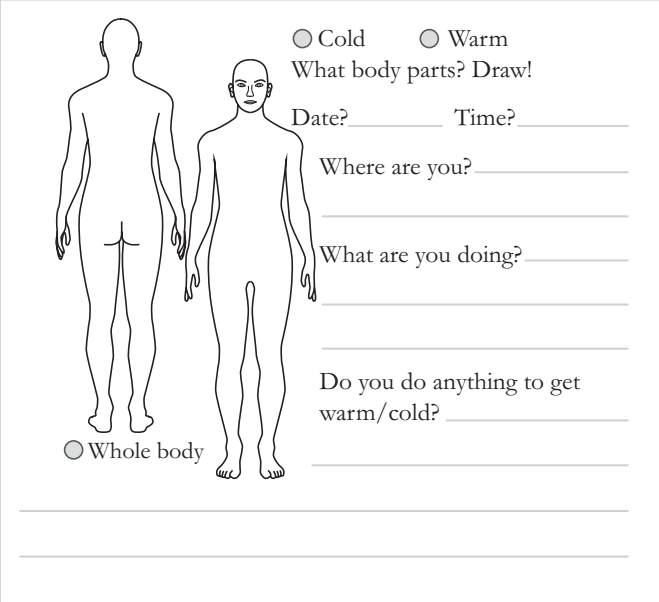

Figure 2. The layout of the thermal diary

2.2 Study II: How is your heating working?

In the second study, the participating households received an annotation exercise via mail and thereafter, the first author visited the households, except for the few participants that preferred to meet at the university. The meetings started with the annotation exercise. This was followed by generative exercises and an interview that are not of interest for this paper. Ten households from Study I volunteered to Study II and eight households were recruited through the local energy company's customer base. Ten households were recruited through e-mails to acquaintances of the authors and their colleagues, or to acquaintances of the participants. Two households were recruited through ads posted in suitable blocks of flats. In total, 30 households participated. In some households, two members partook, resulting in a total of 35 participants, 19 men and 16 women. The mean age was 44 years.

Annotation exercise – personal heating system

The annotation exercise explored what people use to stay warm or to get hot water, i.e. what they include in their personal heating systems. A few days before the visit, all participants got a packet with arrow-shaped notes with statements regarding energy, see Figure 3, inspired by Lockton et al. [18]. The participants were asked to label artefacts in their homes that they use to keep themselves and their homes warm or to get hot water. When arriving to the participants' homes, the interviewer asked the participants to show where they put the notes and to explain why they had put them there. The answers were recorded and the annotations were photographed.

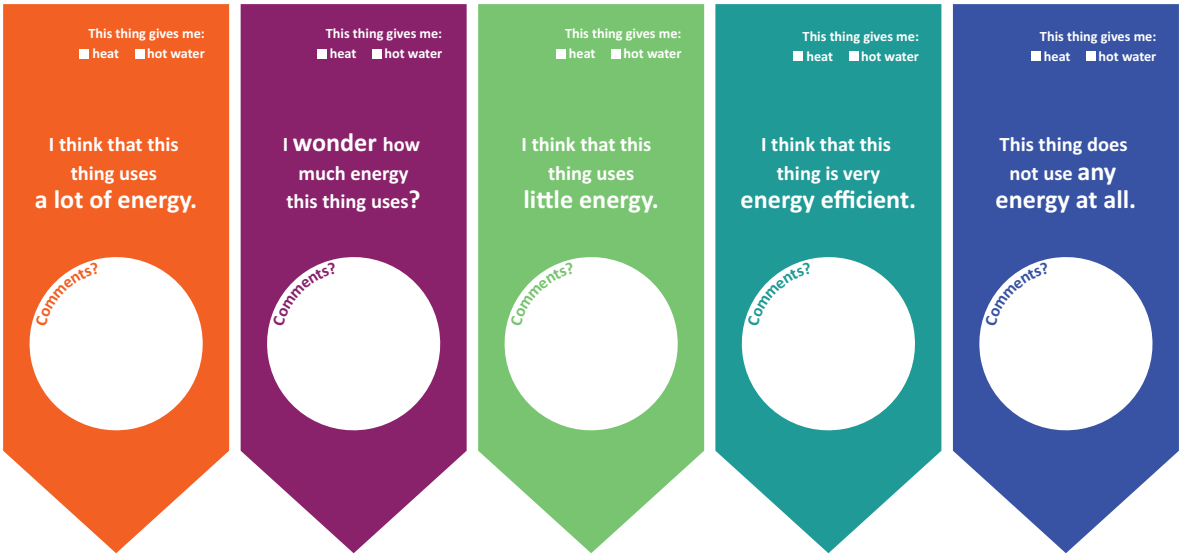

Figure 3. The arrow-shaped notes with statements used in the annotation exercise

2.3 Analysis

Analysis of thermal situation questionnaire

The ordinal scale of choices was substituted with numbers where 0 equalled "strongly disagree" and 5 equalled "strongly agree". Then Friedman two-way analysis of variance with ranks [21] was used to determine if the were statistically significant differences in ratings of the emotions and evaluation words depending on which picture that was shown. Post-hoc analysis was made with Wilcoxon signed rank tests [21] to determine if the differences in ratings between any two pictures also were statistically significant.

Analysis of thermal diary

The number of events of being cold or warm was noted together with the body parts affected and whether any actions to regulate the thermal comfort were taken. The actions were coded using thematic analysis.

Analysis of annotation exercise – personal heating system

The photographs and the recorded comments were examined and coded into two groups: artefacts/actions that the participants found relevant for the hedonic aspect of heating and hot water and artefacts/actions that were not regarded relevant. Only the former is of relevance for this paper. Finally, the hedonic experiences described by the participants in relation to these artefacts or actions were noted.

3. Result

3.1 Result of thermal situation questionnaire

There were statistically significant differences in ratings of the emotions and evaluation words depending on which picture that was shown ($14.054 \leq \chi^2 \geq 93.463$, $p<0.001$). The ratings of the pictures for each of the emotions and evaluation words, including rank, median, and 25^{th} and 75^{th} percentile, are presented in Table 3. The differences in ratings between two different pictures were sometimes significantly different, and in some cases not at all. The extent of the data prevents it from being presented in its entirety in this paper, but the significance level

between the pictures closest in ranking order for each word is presented in the table below. These are in general the highest p-values, as it is for the two pictures closest in ranking order.

Table 3. The ranking order, median, and 25th and 75th percentile of the emotions and evaluation words for the pictures in the thermal situation questionnaire

Emotions/ evaluation words The difference between the highest and lowest median is listed below	**Picture** median (25th to 75th) On each row, the pictures are listed from left to right based on ranking The p-value of the difference in rating between a picture and the next picture in rank (to the right) is also presented below *in italics*					
Anger 0.5	**Cold** 0.5 (0 to 2) *(vs. Warm p=0.431)*	**Warm** 0 (0 to 1.75) *(vs. Cooler p=0.192)*	**Cooler** 0 (0 to 0.75) *(vs. Heater p=0.175)*	**Heater** 0 (0 to 0) *(vs. Insulation p=0.214)*	**Insulation** 0 (0 to 0) *(vs. Neutral p=0.705)*	**Neutral** 0 (0 to 0)
Joy 3	**Heater & Neutral** 4 (3 to 5) *(Heater vs. Neutral p=1, Heater and Neutral vs. Cooler p=0.22)*		**Cooler** 4 (3 to 5) *(vs. Insulation p=0.098)*	**Insulation** 4 (2 to 4) *(vs. Warm p=0.062)*	**Warm** 3 (1 to 4) *(vs. Cold p=0.083)*	**Cold** 1 (0 to 3)
Acceptance 4	**Neutral** 5 (3.75 to 5) *(vs. Heater p=0.015)*	**Heater** 4 (4 to 5) *(vs. Cooler p=0.205)*	**Cooler** 4 (3 to 5) *(vs. Insulation p=0.157)*	**Insulation** 4 (2.75 to 5) *(vs. Warm p=0.001)*	**Warm** 3 (1 to 4) *(vs. Cold p=0.002)*	**Cold** 1 (0 to 2.25)
Surprise 4	**Cooler** 4 (3 to 5) *(vs. Cold p=0.007)*	**Cold** 3 (0.75 to 4.25) *(vs. Heater p=0.049)*	**Heater** 1.5 (0 to 3) *(vs. Insulation p=0.026)*	**Insulation** 1 (0 to 2) *(vs. Warm p=0.792)*	**Warm** 1 (0 to 2) *(vs. Neutral p=0.034)*	**Neutral** 0 (0 to 2)
Fear 3	**Cold** 3 (1 to 4) *(vs. Warm p=0.001)*	**Warm** 1 (0 to 3) *(vs. Cooler p=0.001)*	**Cooler** 0.5 (0 to 2) *(vs. Insulation p=0.154)*	**Insulation** 0 (0 to 1) *(vs. Heater p=0.005)*	**Heater** 0 (0 to 0) *(vs. Neutral p=0.002)*	**Neutral** 0 (0 to 0)
Sadness 0	**Cold** 0 (0 to 1) *(vs. Warm p=0.874)*	**Warm** 0 (0 to 1) *(vs. Heater p=0.005)*	**Heater** 0 (0 to 1) *(vs. Insulation p=0.160)*	**Insulation** 0 (0 to 1) *(vs. Cooler p=0.739)*	**Cooler** 0 (0 to 1) *(vs. Neutral p=1)*	**Neutral** 0 (0 to 1)
Disgust 1	**Cold** 1 (0 to 4) *(vs. Warm p=0.334)*	**Warm** 0 (0 to 3) *(vs. Cooler p=0.01)*	**Cooler** 0 (0 to 2) *(vs. Insulation p=0.063)*	**Insulation** 0 (0 to 0.25) *(vs. Neutral p=0.058)*	**Neutral** 0 (0 to 0) *(vs. Heater p=0.654)*	**Heater** 0 (0 to 0)
Anticipation 3	**Cooler** 4 (2 to 4.25) *(vs. Heater p=0.807)*	**Heater** 3 (2 to 4) *(vs. Insulation p=0.016)*	**Insulation** 3 (1 to 4) *(vs. Neutral p=0.090)*	**Neutral** 3 (0 to 3) *(vs. Warm p=0.888)*	**Warm** 2 (1 to 3.25) *(vs. Cold p=0.007)*	**Cold** 1 (0 to 3)
Cosy 4	**Neutral** 4 (3 to 5) *(vs. Insulation p=0.035)*	**Insulation** 4 (2 to 4) *(vs. Cooler p=0.07)*	**Cooler** 3 (1 to 4) *(vs. Heater p=0.949)*	**Heater** 3.5 (1 to 4) *(vs. Warm p=0.058)*	**Warm** 2 (0.75 to 3) *(vs. Cold p<0.001)*	**Cold** 0 (0 to 1)
Pleasant 5	**Neutral** 5 (4 to 5) *(vs. Heater p=0.016)*	**Heater** 4 (3 to 5) *(vs. Cooler p=0.055)*	**Cooler** 4 (2 to 4) *(vs. Insulation p=0.928)*	**Insulation** 4 (2 to 4) *(vs. Warm p=0.014)*	**Warm** 2 (1 to 4) *(vs. Cold p<0.001)*	**Cold** 0 (0 to 1)

Fascinating 2	**Insulation** 4 (2.75 to 4) *(vs. Heater p=0.849)*	**Heater** 3 (2 to 4) *(vs. Cooler p=0.515)*	**Cooler** 3 (2 to 4) *(vs. Cold p=0.438)*	**Cold** 3.5 (1 to 4) *(vs. Warm p=0.215)*	**Warm** 2 (1 to 3) *(vs. Neutral p=0.543)*	**Neutral** 2 (1 to 3)
Unpleasant 4	**Cold** 4 (1 to 4.5) *(vs. Warm p=0.007)*	**Warm** 1 (0 to 3.5) *(vs. Cooler p=0.131)*	**Cooler** 1 (0 to 2.5) *(vs. Insulation p=0.015)*	**Insulation** 0 (0 to 1) *(vs. Heater p=0.666)*	**Heater** 0 (0 to 1) *(vs. Neutral p=0.002)*	**Neutral** 0 (0 to 0)
Boring 0.5	**Cold** 0.5 (0 to 3) *(vs. Warm p=0.645)*	**Warm** 0 (0 to 2) *(vs. Neutral p=0.771)*	**Neutral** 0 (0 to 2) *(vs. Insulation p=0.282)*	**Insulation** 0 (0 to 1) *(vs. Cooler p=0.482)*	**Cooler** 0 (0 to 1) *(vs. Heater p=0.794)*	**Heater** 0 (0 to 1)
Secure/safe 4	**Neutral** 5 (4 to5) *(vs. Heater p=0.001)*	**Heater** 3 (3 to 4) *(vs. Insulation p=0.502)*	**Insulation** 3.5 (2 to 4) *(vs. Cooler p=0.206)*	**Cooler** 3 (1 to 4) *(vs. Warm p=0.011)*	**Warm** 2 (1 to 3) *(vs. Cold p<0.001)*	**Cold** 1(0 to 1)
Funny 2	**Heater** 4 (3 to 4) *(vs. Cooler p=0.309)*	**Cooler** 4 (2 to 4) *(vs. Insulation p=0.193)*	**Insulation** 3 (2 to 4) *(vs. Neutral p=0.168)*	**Neutral** 3 (1.75 to 3) *(vs. Cold p=0.099)*	**Cold** 1 (0 to 4) *(vs. Warm p=0.836)*	**Warm** 2 (0 to 3)
Dangerous 3	**Cold** 3 (2.75 to 4) *(vs. Warm p<0.001)*	**Warm** 1 (0 to 3) *(vs. Heater p=0.014)*	**Heater** 1 (0 to 2) *(vs. Insulation p=0.426)*	**Insulation** 0 (0 to1) *(vs. Cooler p=0.362)*	**Cooler** 0 (0 to 1) *(vs. Neutral p=0.028)*	**Neutral** 0 (0 to 0)

The combinations of pictures with the highest number of significant differences were: Cold vs. Insulation (15 of maximum 16); Cold vs. Heater (15 of 16); Cold vs. Cooler (15 of 16); and Heater vs. Warm (14 of 16). The words resulting in with the highest number of significant differences between the images were: pleasant (14 of 16); unpleasant (14 of 16); fear (13 of 16); secure/safe (13 of 16); and dangerous (13 of 16). The picture Neutral was strongly connected with secure/safe, acceptance, and pleasant (median=5 and significant difference between the picture next in ranking order). In general, Neutral and the three mixed conditions (Heater, Insulation, and Cooler) were connected with positive emotions and evaluation words. The pictures Cold and Warm were in general connected with negative emotions and evaluation words.

3.2 Result of thermal diary

The participants reported between four and 35 events of being cold or warm during the week they had the diaries. The mean of number of events per person was 25. In total, they reported that they were cold 536 times, warm 289 and both cold and warm six times. In 605 of the reported events the participants took actions to regulate their thermal comfort, while in 236 cases, no actions were taken. The actions the participants took when being cold or warm are presented in Figure 4. For 454 events the thermal discomfort concerned one or more body parts and in 377 cases the thermal discomfort concerned the whole body. The entries were made in February and March in the Gothenburg area in Sweden and the mean outdoor temperature during that period was 1°C.

3.3 Result of annotation exercises – personal heating system

The participants included a great variety of elements in their personal heating systems and many of them were related to both physical and emotional pleasures, see Table 4.

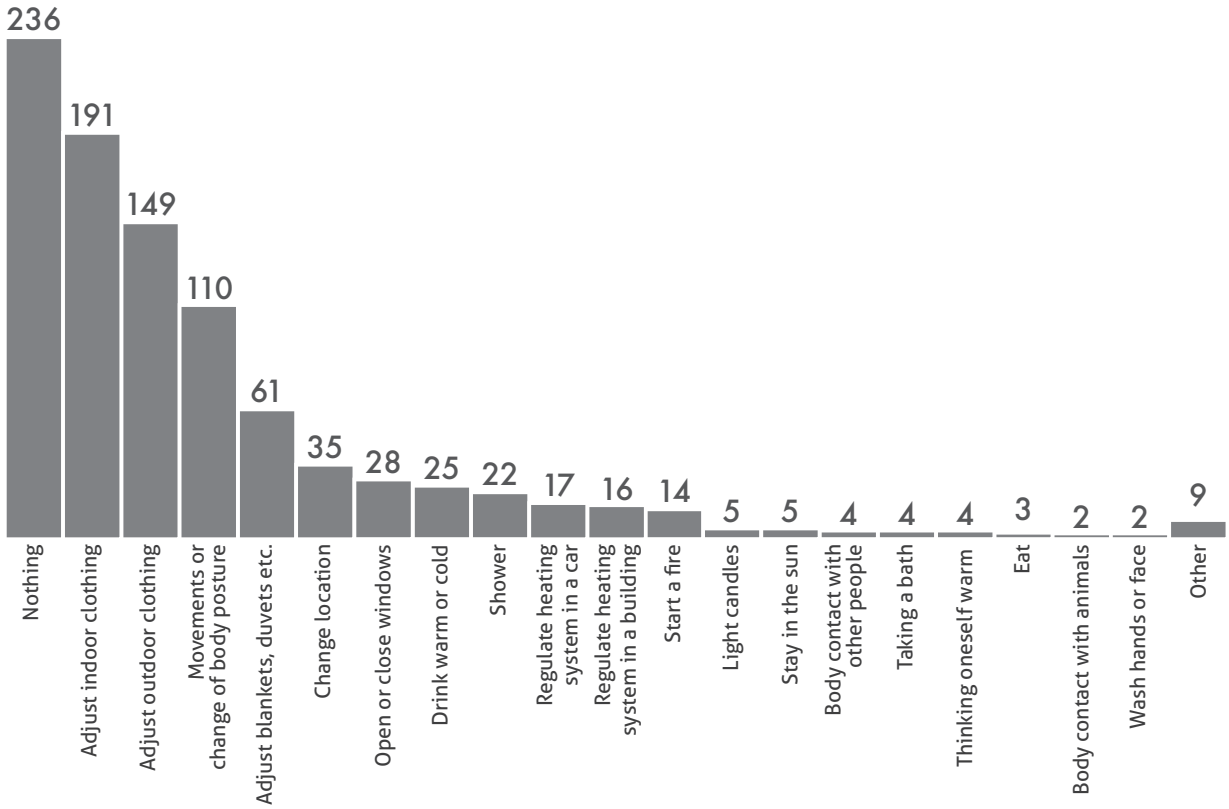

Figure 4. The actions the participants took when being cold or warm, as reported in the thermal diaries

Table 4. Elements in the participants personal heating systems together with mentioned hedonic aspects of use

Artefacts/actions	Mentioned hedonic aspects of use
Shower	Physical pleasure (warmth/cold) and emotional pleasure (e.g. acceptance)
Bathtub	Physical pleasure (warmth/cold) and emotional pleasure (e.g. acceptance)
Family members	Physical pleasure (warmth) and emotional pleasure (contact with others)
Computer	Emotional pleasure (contact with others)
Blankets and duvets	Physical pleasure (warmth) and emotional pleasure (e.g. cosiness)
Wheat pillow	Physical pleasure (warmth) and emotional pleasure (e.g. cosiness)
Candles	Emotional pleasure (cosiness)
Movements	Physical pleasure (warmth) and emotional pleasure (e.g. joy)
Sun	Physical pleasure (warmth) and emotional pleasure (e.g. joy)
Infrared heating (outdoors)	Physical pleasure (warmth in a chilly environment) and emotional pleasure (e.g. fascination)

4. Discussion

4.1 Hedonic experiences in different thermal situations

The choice of using pictures to represent different thermal situations is of course less generalizable than to physically subject people to certain situations. Nevertheless, changing the thermal situation by pictures is quick while changing the thermal situation in reality is rather time-consuming. In addition, pictures can help to better understand people's notions of being cold or warm and the expectations they have in relation to the situations. Pictures showing people were chosen to facilitate for the participants to identify with the situation, but at the same time this may have influenced the participants' interpretations of the situations. However, as the result

corroborates findings from other studies [9, 19], it can be seen as a tentative understanding of the participants' notions of different thermal situations. To confirm the findings a follow-up study with a different set-up and an increased number of participants could be carried out.

Some of the emotions and evaluation words resulted in greater differences in the median values and more often in significant differences between the pictures than others. Therefore, these can be considered to be more applicable in describing the differences between thermal situations. They can also be seen as an array of possible attitudes towards the consequences of using different heating systems and additional heating artefacts.

Ho et al. [9] showed in an experiment with response time measurements that physical warmth and semantically described warmth were associated with positive emotions faster than coldness was. Physical and semantically described coldness was instead associated with negative emotions. Even though these findings support the overall findings in the thermal situation questionnaire, there are also indications that different ways of staying warm could result in different positive emotions and evaluations. To be in a cold environment with an external heat source was, in this study, rated higher on anticipation than being in a cold environment with insulation or to be neutral. For the evaluation word cosy, the rating for Neutral was significantly higher than being in a cold environment with insulation (Insulation) or with an external heat source (Heater), while it was more fascinating with the cold environments. This is interesting, especially as the six thermal situations would differ in energy consumption if they would represent indoor thermal situations. If comparing the three pictures Insulation, Heater, and Neutral the latter could be said to represent a neutral indoor temperature while Heater would represent a cooler indoor temperature, but with person heating, i.e. using artefacts that heat the body directly, such as hot water bottles or portable electric heaters [15]. Insulation would also represent a cooler indoor temperature but with warm clothes, blankets, or duvets. Similarly, Gram-Hanssen [7] found that having a cosy and welcoming home for some families meant having a rather high indoor temperature. Instead, other interviewees considered a lower indoor temperature to be more pleasurable as they thought of it as more natural and sleeping in a low temperature to be healthy.

4.2 Hedonic experiences when using heating systems and additional heating artefacts

In the great variety of artefacts and activities the participants used to achieve thermal comfort, both physical pleasure and emotional pleasure were present. Some experiences were more related to the hedonic sub-goal convenience, such as taking on and off clothes or adjusting the heating system, while other experiences were more related to the sub-goal stimulation, such as infrared heating outdoors or starting a fire. Thus, physical as well as emotional pleasure in relation to both stimulation and convenience seemed to be present in the participants' everyday pursuit of thermal comfort. To establish to what extent the results are generalizable an extensive study with more participants would be needed, preferably in different cultural contexts and climates.

An interesting aspect was that some participants used artefacts that only gave emotional pleasure to achieve thermal comfort, such as candle lit "for the feeling of it" or computers that allow contact with others. Similarly, studies have shown that increased social proximity generates higher perceived room temperature [12].

It was seen that physically and emotionally pleasurable use of the heating system, such as long hot showers, and long-lasting baths consume high amounts of energy, while many of the additional heating artefacts do not use energy at all during the use phase – such as blankets. In addition, such additional heating artefacts can deliver both warmth and emotional pleasure. Of course, not all additional heating artefacts are resource efficient; and candles, often used exclusively for emotional pleasure, produce both carbon dioxide and soot.

4.3 Pathways towards reduced energy consumption

Pleasure is the third level of consumer needs, following functionality and usability [13]. Although heating systems often have usability flaws resulting in suboptimal use [3], usability improvements alone are unlikely to successfully encourage energy conservation. Instead, an alternative is to encourage pro-environmental behaviour by making the hedonic and normative goal-frames more compatible. This can be done by making people feel good about pro-environmental actions [17]. An example of this is a measuring cup designed to encourage moderate dosing of washing detergent. Inside the cup is a plastic frog on a small stone. The frog's feet represent a moderate dose and if more detergent is used the frog drowns in detergent, a metaphorical representation of what happens in nature. The users experience positive emotions as they save the frog when dosing moderately but also because moderate dosing is considered to be the appropriate thing to do [16]. Likewise, hot water and heating systems and additional heating artefacts could be designed in a way so that reduced energy consumption feels good because it results in an immediate positive emotional experience and at the same time is perceived as the right thing to do.

The physical and emotional pleasures experienced by the participants when using non-energy consuming heating artefacts and when engaging in non-energy consuming activities can be explored in more types of products than currently existing. Such heating products should enable people to continuously engage in energy efficient ways of achieving positive thermal experiences in everyday life. An example of this is the concept Splash, designed as an alternative to conventional showering. In Splash, the water is contained and splashed over the body resulting in a relaxing experience and simultaneous energy savings compared to conventional showering [14].

In the thermal diaries, a majority of the reported events of being cold or warm concerned only parts of the body. This allows for products that enable more direct heating or cooling of one body part instead of the whole body via increased room temperature. However, when introducing new ways of achieving positive thermal experiences, there is a risk for rebound effects due to altered expectations [15].

5. Conclusion

In the two studies it was found that thermal situations and the use of heating and hot water sometimes are hedonic experiences in a physical and emotional sense, relating to both convenience and stimulation. Hedonic experiences were present in the use of additional heating artefacts and in the use of hot water and heating systems. Some additional heating artefact used for physical and emotional pleasures did not consume energy, while hedonic use of hot water and heating systems always required energy. Although heating systems often have usability flaws resulting in energy waste usability improvements alone are unlikely to successfully encourage energy conservation. Instead, the authors see an opportunity to design heating artefacts that are pleasurable to use in a pro-environmental manner by taking the hedonic experiences in different thermal situations and in use of additional heating artefact as a basis.

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