Collaborative design sessions of objects proposing energy-saving practices[1] [2]

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Short biographies

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[2] In this paper, F. Jégou wrote part 2.3; 2.4 and 3. G. Wallenborn wrote parts 1 and 4. J. Liberman wrote part 2.1 and 2.2.

1. Introduction: designing practices

In the search for more sustainable consumption patterns, “behaviour change” has become a motto. A usual way to deal with this aim is the idea to change first attitudes of consumers, so that a behaviour change will follow. There is however more and more research showing that *practices* are not changing so easily, especially when consumption is inconspicuous as it is the case of household energy consumption (Shove 2003, Jackson 2005). From the point of view of design much of the political agenda is on *ecodesign*. According to the directive 2005/32/EC “establishing a framework for the setting of ecodesign requirements for energy-using products” (EuP), ecodesign means: the integration of environmental aspects into product design with the aim of improving the environmental performance of the EuP throughout its whole life cycle”.[3]

As our research has shown, the preparatory studies for implementing the ‘ecodesign directive’ are mainly based on technological considerations; uses and users are hardly considered (Wallenborn & al. 2009). Besides the necessary energy efficiency improvements, the question of sufficiency is never asked. Though efficiency and sufficiency are generally considered as opposite concepts and strategies, we think we have to make them complementary. Indeed we ought to combine acceptable additional efforts for the users (sufficiency) with improved usage process (efficiency) and explore how to 'do nearly the same with less'.

While we know we have to transit quite fast towards a post-carbon society, the active role of users and their interaction with their appliances are hardly envisaged. The problem is that the environment does not appear in households’ daily practices: households do not consume energy, they uses different objects that give them services. Therefore, rather than starting from attitudes, we think it is essential to start from what people are doing, from their everyday practices (Ropke 2009). In their daily life, households are engaged in practices (cooking, washing, working, entertaining, etc.) that are meaningful to them. Energy consumption is only one aspect of these practices, and it usually comes unnoticed.

Manzini (2009) pleads for a design that would overcome the pitfalls of eco-efficiency and those of the individual choice as a sustainable solution. But how could design start from households’ practices? How to design products that may influence users towards new and more sustainable practices? Beyond the eco-efficiency of domestic equipments, is it possible to think them so that they suggest to their users they should be used in a thrifty way? Design generally pushes consumption and tends to be part of the problem: how to use the same

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[3] http://ec.europa.eu/energy/demand/legislation/eco_design_en.htm

design skills to enable households to shift their practices more in line with a sufficiency principle? How could new interfaces empower user rather than making them impotent?
There is an abundant literature about objects, their use, user-centred and participatory design, and the links that can be made with Science & Technology Studies (Weedman 2005, Shove & al. 2007). The notion of *script* exemplifies well the kind of thought in this literature. When objects are designed, they are infused with the description of the user's behaviour. But more than that, the objects are designed for allowing certain behaviour and counter others. Jelsma (2003) defines scripts as "the structural features of artefacts encouraging certain user actions while counteracting others". Scripts have a prescriptive force that steers users in a certain direction. The symmetrical concept, from the point of view of appropriation by users is the *affordance*. In these narratives objects and users are actively interacting. We have however to acknowledge that the way users and objects are considered are usually far away from this active power.
There are currently two dominant ways of considering users, as hedonistic or as rational. The hedonistic point of view describes how households are currently consuming their energy, as is revealed in different studies (e.g. Shove 2003). In these situations, consumers are mainly moved by their research of pleasure and comfort. Energy-using products are seen as devices providing enjoyable services: in their daily practices, households do not realise they are consuming energy. Household's capacities of action are not intrinsically limited, but they are always inclined towards easiness. From the rational approach point of view, the individuals are considered as rational actors that act on the basis of a valuation of their actions. In this perspective, the role of policy is to organize the conditions for this rationality to be effective. Policies must make available the right information, at the right moment. It must standardize and encourage customers to choose correctly the products. This point of view is mainly present when speaking about the moment of buying an appliance. Rationality means here that users calculate and optimise their use of resources.
If we remain hesitating between both hedonistic and rational approaches, we are stuck in the famous 'attitude-behaviour gap'. We propose therefore a third approach that is found in the literature on design or learning, for instance (Pantzar 1997, Darby 2005). We call this approach *experimental* or *relational*. The sufficiency can only be addressed in this approach because humans are not predetermined, they are relational, they change when they get in relation with objects (Thevenot 1994, Debaise 2004). Humans and their desires are produced in their relationship with the objects they have. It is the situation in which people are that determines their own behaviour. The reality of this approach is a process: it emerges from action, from practices, and can be discovered only in the concrete relation with the appliances (Reckwitz 2002). According to this point of view, the cultural situation is not fixed.

The desires of the consumers and what they are ready to accept can only be discovered in the meeting of new situations and objects.
What happens when households are placed in other situation than hedonistic or rational? What are they able to create as new device enhancing changes in user energy saving behaviour? This is the starting question of the present paper. We will present some results of the collaborative sessions with households, centred on 4 household appliance categories: lighting, heating regulation, washing machine, computer. These co-design sessions with users lasted 6 months and were conducted by Strategic Design Scenarios and Égérie Research, Belgium. Families were invited to collaborate and to participate to design sessions to define together with design teams, innovative design strategies and related sets of domestic appliances likely to induce energy-saving practices. The first part of the paper presents the collaborative work with the users, the tools and interactions used to ensure their involvement in the design process. The second part describes the results obtained at a methodological level proposing four design guidelines to engender energy-saving practices. This paper focuses on the process brought by the co-design of new heating regulation systems. By contrast, these experimental situations show how much our current heating regulation systems are rigid and provide a homogeneous temperature whereas more flexible, time- and space-dependent temperatures would be more in line with practices.

2. Collaborative design with users

The co-design sessions with users has been developed during 6 months in four phases starting with online discussion with 16 families, discussing their energy consumption patterns, exchanging pictures of their living contexts and progressively building trust for the second phase of self-investigation training and ethnographic observations at their homes. The third phase has invited the families to work together with design teams at Strategic Design Scenarios offices and to co-design new product concepts. Finally the fourth phase consists in delivering to the families, mock-ups of the products they co-designed, makes them familiarise with these new equipments in their homes, and asks them to describe why they think these new appliances are likely to improve their energy-consumption practices in front of a video camera. The short video clips of users presenting their involvement in a design process, the results they obtained and the behaviours changes they expect will feed the following of the ISEU research project, in particular to stimulate qualitative discussions with larger samples of users as well as designers and producers of domestic appliance.

2.1 Casting online

"First, let's start with knowing each other better!"; "Could you introduce your family? You and the children..."; "What is your professional activity?"; "What about your house?"; "I can't imagine where you live... Could you send us some pictures? "How do you feel in your neighbourhood? What is the atmosphere?"; etc.

The collaboration starts with an exchange of mails with the different families involved. The initial recruitment focussed on 16 middle class households different in size, incomes, age, type of housing and family status. But the discriminant criteria of selection were their motivation to reduce their household impact on the environment, their concerns for sustainable issues and above all their willingness to take part and play with all family members together in a series of exchanges, dialogues, meeting on the theme: "We will control our energy consumption". This last criterion is fundamental for the success of this type of participative design. Compared to proper qualitative/quantitative investigation, the representativeness of the sample is much less important that the openness of people to collaborate both in giving access to their contexts of life and in exploring their current life patterns. The scope of the process is not to test the potentials of any market proposal but to generate new ideas that could change ways of using energy. Whereas classical marketing approach is completely oriented towards identification of existing trends in order to conform to them, the goal is here different, quasi-opposite, searching ways to escape trends, exploring practices in depth and activating different human inclinations than the ones leading to today's overconsumption of energy. It is a real 'casting' process similar to selection processes of actors. For their 'role in the film' we have actively searched for users who exhibit specific characteristics like curiosity, flexibility, positivity, instead of inertia, conservatism and egocentrism.

The conversation by mail was carried on during 4 weeks bringing progressively the families to talk about the 4 categories of products selected by the ISEU project: *"How are you organised in your family with the laundry?"; "How frequently do you adjust the heating regulation? Who is in charge of setting the temperature?"; "What is going well with the use of the computer at home? What's less easy?"; "Could you tell me an anecdote about the use of the lighting system in your family?"; etc.* this technique has been inspired by the analysis of trust building process in peer-to-peer relationships on Internet. For instance, how people living 6000 km from each other and who never met before manage to become progressively confident enough to exchange their respective houses during summer holidays? They get in contact through a website, exchange their email addresses, began to talk about where they live, what their houses look like, how many bedrooms are available for the kids and if they would agree to feed the cat... Progressively they discuss a wide range of subjects, disclose

more personal and intimate elements as long as they fell more confident in the relationship and after 15 to 20 exchanges they feel safe (or sometimes not) to leave the key of what is probably their most valuable property to strangers that have become friends.
In the ISEU project, the process was similar but shorter and after 6 rounds of mails exchanges, 8 households out of the 16 initially involved in the first phase were short-listed according to the above criteria and invited to take part in the second phase.

Figure 1. Sample of exchanged mails with the recruited families during the casting process.

2.2 Visiting 'friendly users'

The purpose of this approach is to involve users in ideas generation process to stimulate and 'debug' designers' creative thinking. The previous phase aimed at selecting 'friendly users' which value is less in their testing capabilities and market representativeness than in their willingness to design a supportive environment toward new and more sustainable way of living (Snyder 2003, Sanders & Stapper 2008, Jégou 2009). Reciprocal to the concept of 'user friendly' where physical environments and objects are designed to facilitate users tasks in everyday life, the idea of 'friendly users' focuses on people who are encouraging the emergence of new projects, trying to bring constructive critics, to suggest improvements and to overcome imperfections of early prototypes.
In the second phase, families are proposed to host the project team at their home around a cup of tea or a glass of wine. Here again the protocol is inspired from real life typical socialisation situation such as between neighbours inviting each other for a drink and generally a short tour of their house.
The aim of this informal visit is to better understand the specificities of the different contexts

of life and their potential interaction with energy consumption related practices. As any ethnographic-like approach, the purpose of sharing some moments of family life is to check differences between what they declare and what they effectively do, to link their judgements to the context in which they live and to better understand their aspiration from their current situation.

Marie-France D. advocates for programmable thermal regulation but she proves to be incapable (as many other users) to explain how her quite complex device was working. Olivier M. stigmatises his wife for her excessive use of additional heater in the bathroom but it appears that himself plays computer games late at night and leaves an electrical blanket on to get his bed warm when he finally decides to go to sleep...

Beyond the confrontation between perceptions and reality, immersions in households' life, even for short periods, allow empathy with the users (Evans, Burns and Barrett, 2002). In a project-oriented process, the experience of real bits-of-life is often a rich stimulation.

Most of the visited households have a main central light in each room. In living rooms they tend to be never switched on and more disseminated ambient lights are preferred. Therefore they tend to become 'off-lights' perceived mainly for the design of lighting and its decoration effect in the room. In the kitchen and in bedrooms central lights are also inconvenient because they project shadows on the peripheral working surfaces and in cupboards and wardrobes. But by default, they correspond to the main switch at the entrance door and users switch them on when they enter the room and add a second specific light for the task they have to perform...

Finally, immersion and empathy with users in their living situations, allow partly to overcome the non-representativeness of the sample of users involved. Chatting in the garden with the dog playing around, passing from the laundry waiting in the basement to the computer in the attic, visiting the bedrooms following the kids, etc. give access to a quick and global comprehension of the users. It allows to guess more accurately where are the effective motivations and contradictions of each individual and finally to differentiate singularities from the general in the observations.

Joëlle H. declares to be a 'waste buster'[4] but she reveals to be excessively chilly. This particular contradiction forced her to be inventive in finding a series of tricks (e.g. silk underwear and flannel bed linen in the winter, reading in bed rather than in the sofa...) to save energy while keeping an acceptable comfort. Joëlle is very typical as she encapsulates an extreme version of the contradiction between sustainability and individual

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[4] This French speaking Belgian person refers to a very remembered advertising campaign for energy saving launch by the French government in 1978 and based on the slogan: "La chasse au Gaspi", literally “hunting the Waste”, that embodied the wasting habits of the population as a nasty animal to be busted.

comfort.

Figure 2. Joëlle H. is highly respectful of the environment but very chilly. She has therefore developed a wide range of tricks for her and her 2 daughters in negotiating with this contradiction: the family computer is installed in the attic where there is no heating so that the connection time is 'automatically' regulated; a kitchen timer is installed in the shower to remind that 10 minutes is enough...

2.3 Discussing proposition cards...

Beyond empathic immersions in families' contexts of life, those visits intended also to discuss some hypothesis of alternative design for energy using domestic appliances. A series of 4 to 8 breakthrough alternatives in terms of users practice changes were proposed to the families for the 4 categories of products focused by the ISEU research:

• *In order to avoid heating an empty room...*

...when I go out of a room, I switch off the radiator. When I come back I switch it on again and an auxiliary radiant system gives an immediate feeling of warm while the radiator gets warm again.

• *In order to heat only one room at once...*

...in the house, we have a mobile thermostat: we move it along with us, it's warm where we are and the temperature is a bit lower everywhere else in the logging...

• *For a reduced temperature except when I need it...*

...the thermostat of our home is set to a somewhat lower temperature and there is a 'one hour' button that provides a short temperature boost as if we would add a log in an open fire...

• *In order to reduce the temperature without feeling cold when I don't move...*

...in the living room, we keep the temperature somewhat lower and we have a warming

sofa that balances locally the temperature when we feel chilly in front of the TV.

The ideas introduced may not be innovative as such: some were very banal propositions but they all potentially may represent important shifts in the current behaviours of the users.
The propositions were presented through a set of cards that systematically:

- intend to save energy;
- show a domestic situation implementing the proposition;
- describe the proposition as if it was a quote from a user and therefore an already existing practice.

This presentation was designed in line with the previous phase of discussions by mail. Actually it intends to look like an excerpt of one of these mails: informal speech from conversation between neighbours; a functional picture showing what it is about... The pitch is peer-to-peer advising. The purpose is to confront the hosting family with statements of other people who organise their domestic environment in different ways. These statements are, on the one hand, realist since some people are living like that and, on the other hand, tends to facilitate engagement since nobody criticises my current way of doing: I am just showing that doing in another way is also possible and enjoyable.
The very form of the cards allows the users to manipulate literally the different propositions: they keep close the one they like and remove the other; they group what they assess as complementary or of the same nature and they progressively organise a hand of cards they feel more comfortable with or interested in.

Figure 3. Example of proposition cards and users discussing their opportunity and conditions of implementation at their homes.

2.4 Playing design games

The third phase of the participative design with the families consists in proposing them to take part to some of the design projects they contribute to trigger in the previous phases. The proposed context is completely different: families were no more in their domestic environment. Two families were invited for an evening in a design consultancy in Strategic Design Scenarios offices. Learning from the previous steps is shared with them and 2 design exercises are proposed lasting about one hour each.
The discussions around the proposition cards focusing thermal regulation devices raised a series of design demands as for instance:

- proposals going toward the 'animation' of the rather 'flat heating setting' in the logging seems to be welcome especially when considering to lower the overall temperature of some degrees: introducing in the living space 'warm points' (such as a warming sofa or carpet providing a zone of comfort when staying immobile) or 'warm moments' (such as a one-degree-more for-one-hour button on the thermal regulation device). Both suggestions are metaphors of an open fire: when filling chilly, one can stay closer or add a piece of wood. In terms of usage, it seems to advocate for 'areas of compensation' in a perspective of heating reductions in logging.

- proposals of differentiation or even of individualisation of the temperature seems to raise interests: a mobile thermal regulation device allows to privilege or secure accurate temperature in rooms where the family is gathering; individual thermal regulation devices would follow each member of the family across the living space ensuring to heat only occupied places. Behind this design direction 2 issues are emerging: latent conflicts within families about setting the temperature could be find solutions in the possibility to adjust it easily in each room. Substantial economies of energies could be done with a more refine possibilities to adjust the temperature in space and time.

More fundamentally, the diffusion of central heating allow an important step forward in logging healthiness and related health of tenants. It also induces a radical shift in the way heating was performed and perceived: the ideal of uniformity of the temperature and after of automated control brought to a partial disappearance of heating in household daily living. Compared to open fires, stoves or other localised traditional systems, central heating ensures the same temperature all over the logging without requiring any daily maintenance. Thermal regulation systems progressively sophisticates in self-regulating devices

compensating outside variations and maintaining the same temperature inside, adjusting different temperature during night and while household is out : for the users the heating system disappears from daily living assets and concerns. It become a *negative quality* (Trini Castelli, 1985) which is to say a dimension that is given for granted and perceived in negative in the everyday life, only when it is missing if for instance the heating system failed to work.

As a consequence of this established quality standard of heating systems, regulation of heating in each rooms is neither technically facilitated nor welcome by users. When available and effectively working, thermostatic taps allow introducing differentiation of temperature between rooms especially for not occupied guest rooms. Only very compliant users are adjusting thermostatic taps according the places they occupied along the day and many rooms are heated while nobody stays in there.

A transition towards a more rationale use of energy would therefore imply to break this paradigm of uniform and constant temperature of central heating and to facilitate fine regulation of temperature according places and time in the habitat.

For the heating topic, the design exercises were then focussed on co-design of new thermal regulation devices starting from the user point of view. We will go ahead presenting 2 examples in that direction.

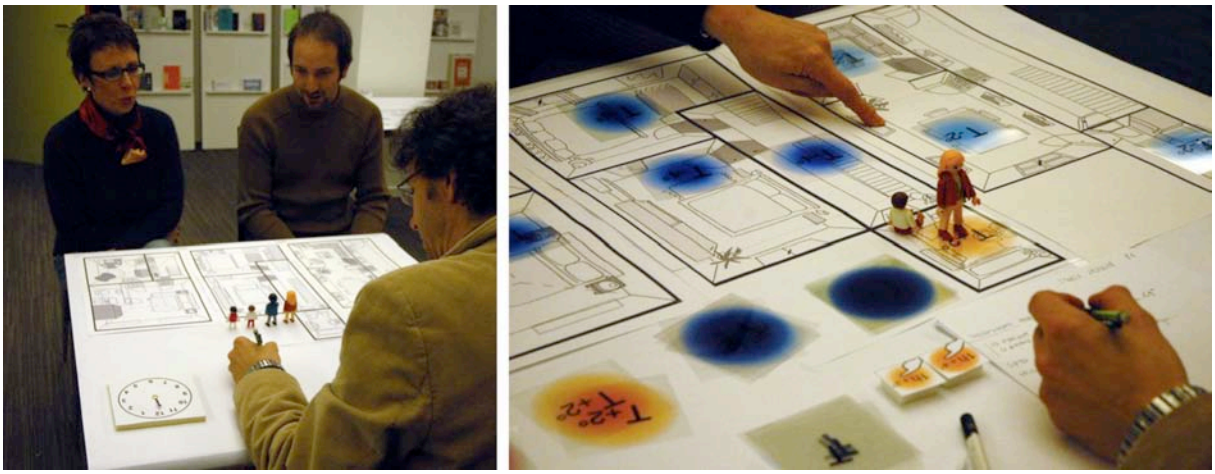

Figure 4. 'exploration' type design exercise aiming at mapping effective family requirements of heating in each different types of rooms of the logging.

The first design exercise is a type of *exploration*: the aim is to investigate a domestic function with new eyes and trying as much as possible to get rid of the current practices.

A single house is proposed to the 2 participating families in the form of a top view of the 3 floors. The family living there is represented by 4 figurines in scale (a mother, a father and 2

kids) and furniture is already in the space. A 'reasonable/acceptable' temperature in the house is referred abstractly as "T" to avoid disagreements between the two participating families. Starting from this common basis, possible variation are defined as less or more than T, showing respectively opportunities of more energy savings and moments where more heating is required. Five corresponding sets of card with "T-4°"; "T-2°"; "T"; "T+2°" and "T+4°" are proposed to the families and a clock is set to the hour when they are supposed to get up. The briefing is to define what is the temperature they would like to have in each rooms of the house in order to reduce as much as possible the consumption of energy. For each moment of the day the two families discuss trade-offs and temperature cards are displayed in each rooms. The cards have different colours for each different temperatures and a zenithal camera captures the evolving thermal mapping of the house along the day. The acceleration of the movie gives an overview of the thermal profile of each room and a precise transcription of the temperature variations in a graphic allows spotting the main opportunities to rationalise energy consumption. For instance, parents tends to spend in their bed most of the time when they are in their bedroom and therefore covered with blankets and requiring less heating; young kids are getting in bed much earlier than the rest of the family allowing to start the night temperature much earlier in their rooms; cooking periods in the kitchen requires less temperature both because people are active and because additional heat is provided by cooker and oven.

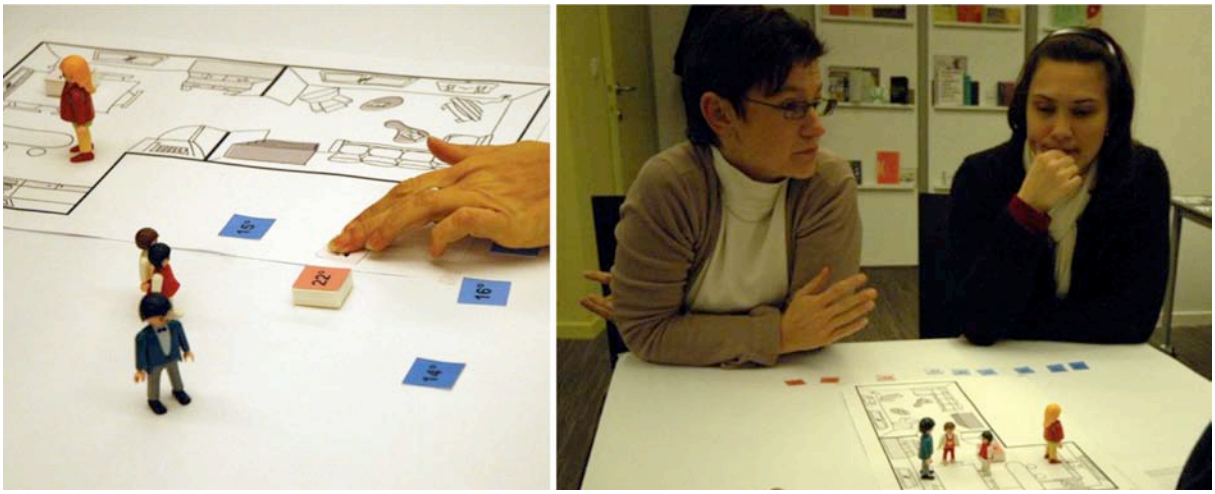

Figure 5. 'Performance' type design exercise aiming at 'stretching' potentially promising strategies in rational use of energy over daily living activities.

The second example of design exercise is a kind of *performance*: it starts from a given strategy engaging in new energy-saving practices, and the aim is to explore both its efficiency and its attractiveness for the users.
The promising concept was here based on the idea of differentiating the temperature within the same room building upon usage patterns observed with an oven or an open fire: the

setting of the furniture and the interior design of the room is thought to benefit from the most warming zones leaving areas around with lower temperature. In terms of energy consumption, the convection of the air will tend to reduce the difference of temperature within the same room but from experience, a fireplace provides a local thermal comfort with gradual decrease of some degrees that remains around.
The two participating families were provided with a similar setting of the previous exercise: a top view of a large living room and a family in figurines to move around.
At start, two temperatures of comfort instead of traditionally one are discussed: a 'comfort-low' corresponding to moments of physical activity moving around, doing housekeeping shores... and a 'comfort-high' corresponding to moments of relative immobility sitting in chairs or in sofas... Beyond this specific manual adjustment between two temperatures of comfort, the device works as any other thermal regulation device setting automatically a (third) temperature of 'stand-by/economy' lower than 'comfort-low' during the night or when users are away. When agreed, those two temperatures are marked on both side of a small card simulating thermal regulation device that can be moved around in the living space and turned upside-down to set either 'comfort-high' around where the device is situated in the space and less beyond or 'comfort-low' in all the space. The briefing to the participating families is to use the mobile/manual thermal regulation device in order to reduce energy consumption while keeping an acceptable comfort for all members of the family.
A camera tracks the movements of the card figuring the device and manual changes of temperature. Discussions between the two families along a fictive day tends to show that the hypothesis of a mobile/manual thermal control device makes sense: the pleasure to play with a sort of remote control materialising the thermal comfort seems to compensate the increase in cognitive overload of the users to 'move' and 'adjust' the temperature along with their activities. The manual adjustment of the temperature and the 'presence' of the device on the kitchen of living room table seems to stimulate users to ask themselves what kind of temperature (low or high) they need for each of their activities while limited setting between two temperatures reduces the zapping effect.

The results of both exercises are real design activities, not in the sense of shaping the external form factors of a product but of tracking emergence of new scenarios of interaction between users and products. They go much beyond classical testing of given products on the one hand and on the other hand, users are not designing products alone: it is more a matter of collaboration between professional of innovation (the design team) and professional of usage (the families), both keeping their particular interests and bringing their respective skills to the definition of new propositions.

3. Translating sufficiency into design guidelines to engender new practices

For each of the 4 categories of domestic appliances focused by the ISEU project an original interpretation of the current situation emerged from the early investigations with the families, showing why according to them the current appliances proposed on the market were not facilitating energy-saving practices or, worst, were favouring energy overconsumption. For each category of equipment, a new design attitude has been identified between the users and the design teams that brought, on the one hand, to a series of emblematic concepts of new products and, on the other hand, to four design guidelines to favour energy-saving behaviours with a general value going beyond the product category they emerged from. For each product category, the sufficiency principle has been translated into more concrete principles.

- ***"Subtractive principle and lighting environment"*** allows imagination of new light switches and light distribution in the living environment to minimise the number of lights on;

- ***"Semi-manual interface principle and thermal regulation"*** reduces user cognitive overload in the fine thermal regulation with systems set to peoples' habits at home while facilitating users manual regulation;

- ***"Resetting default principle and clothing care"*** allows to prompt low energy-intensive washing processes and to push evolution of users habits;

- ***"Eco-conscious artefacts and smart energy meters"*** facilitates interaction of users with energy metering enabling them to streamline household practices.

We will develop here more in depth the second principle and the resulting products going ahead with the case on thermal regulation.

Thermostats and indoor thermometers are generally discrete objects, small, applied to a wall so that the information they make available requires that the user is interested and close to it. The ambient temperature in particular is much less present as the clock in the domestic world. The design of control systems for heating ranges from the ideal of fully automatic to the entire delegation to the user of the fine modulation for each room. For the regulation of the whole apartment, models of thermostats tend to sophisticate and combine daily and weekly programs requiring the user first to clarify explicitly its practice and second to set up a

complex and often unlovable interface. For the fine control of each room, systems are on the contrary much more primitive and involves complacency from users who should intervene manually on each radiator valve whenever they enter or leave a room.

For this reasons we have explored what we call the semi-manual principle develops systems that operate autonomously, controlled by programming aiming at achieving economy of energy but at the same time allowing the user to easily alter them intuitively in order to adapt to the displacement in the domestic space or to provide occasional additional temperature only when required and so doing increase the potential of economy of energy in space and time.

3.1 Rooms thermostat switches.

The application of the semi-manual principle presupposes to facilitate access to thermostat device in all rooms of the logging and make of it a visible, visually appealing in order to recall attention of the household members. The proposed device assumed the status of a light switch situated on the wall at entrance of each room to facilitate and prompt users interaction.

The device works as any thermostat allowing to define a basic programming of the temperature in the corresponding room independently: young children go to bed early and the night temperature begins at that time in their bedrooms; parents are rarely in their bedroom during the day so that the absence temperature is maintained until late evening...

Beyond this basic programming made at the outset, the thermostat works like a very simple light switch and allows to change manually this programming: leaving a room for a while the user may set its temperature in stand-by mode, reducing energy consumption in consequence. When coming back with the intention to stay in the room for a sufficiently long moment, the user will switch off the stand-by mode and the room will get back to the 'presence temperature' set on the device.

But if manual interaction with a room-specific thermostat may be accessible as switching on and off the light, this strategy may not work as such in practice: heat is less sensitive than light and less compliant users may forget about it and even more than light skip setting the thermostat off when changing rooms.

The form factor of the device are therefore designed to enhance the visibility of the heat and counterbalance the 'disappearing effect' induced by the central heating described before.

The 'thermostat-switch' is based on a small touch screen that displays the status of the heating system by visualising the activity of the burners of the boiler. The screen is a metaphoric evocation of the control window of a stove or a water boiler: it makes heating

‘visible’ as a virtual fireplace. Flames covers all the screen when the normal 'presence temperature' is provided. Flames reduce to half-screen in stand-by mode when the radiator of the room maintains a lower 'absence temperature'. Touching the screen the user switches between all burners on to only half of them. Beyond the explicit expression of the status of the heating system and the aesthetical value of reconnecting the household to the energy used for thermal comfort, the purpose of this form factors is to recall attention of users: dancing flames 'show' literally the temperature. They confirm that the radiator is on and the user can check status at glance. In the same way, active burners prompt the user to wonder if heating is really needed or if some economy maybe possible.

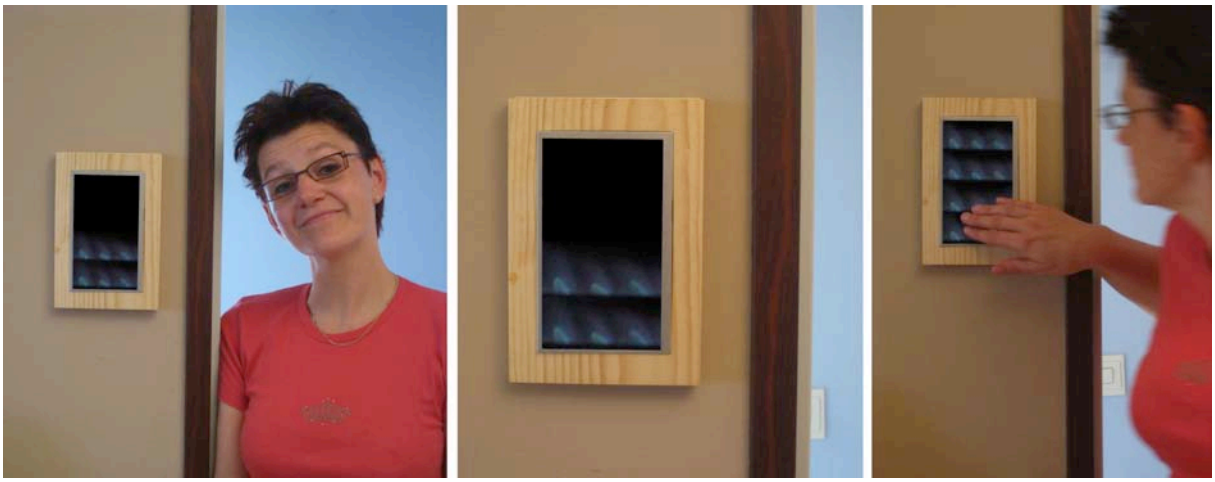

Figure 6. Dominique B. is presenting the mural thermostat switch to be operated like a light switch when going in and out of the room. The touch screen shows the activity of the burners of the boiler, materialising metaphorically the heating system and recalling attention of the household to switch temperature to stand-by mode in empty spaces.

3.2 Modulating the automatic thermostat.

The semi-manual principle applied to the design of thermostats may also leads to get the object in the daily life of the user, giving it a status closer to that of a remote control found on the table that moves on and with which we interact more easily. This *remote thermostat* regulates the room temperature according a pre-set temperature schedule switching automatically between night/absence mode and day/presence one. On top of this common setting similar to any thermostat, the day/presence mode lets you play between a temperature of 'comfort low', or 'economy', sufficient when actively moving in the domestic environment and a temperature of 'comfort high' required when standing still in a sofa or at the desk.

In the day-presence mode the thermostat activates by default the 'comfort low' temperature corresponding to the best compromise between sufficient warm in the apartment and economy of energy. This compromise is acceptable for most of the activities of the

household from kids playing in the living room to parents preparing the dinner or doing some household chores. But in precise situations such as kids doing homework in their rooms or the family reading or watching television in the living room users requires a slightly higher temperature. This situation recall a traditional house with open fire or stove where ours grand parents were accustomed to maintain the fire during the day and to add a log or a shovelful of coal when some extra heat was needed.

In the same way, the *remote thermostat* allows to set a short 'heating push' when needed. It works as a kitchen timer: turning the bottom part to the right will set the temperature to 'comfort high' for a period up to 60 minutes. When the delay is expired, the *remote thermostat* will switch automatically back to 'comfort low' and the temperature in the room will decrease slowly. Users may metaphorically put another piece of wood in the fire if they need to or leave it if they don't feel the necessity of another supplement of heat.

This interaction mode is another design strategy to evidence the use of energy in the household: the fire smoulders all day long but heating boosts require attention and regular maintenance from the user side. The eventual reset of the *remote thermostat* is not an heavy burden for the users but it sets the increase of temperature as a temporary and voluntary reasoned act.

The *remote thermostat* is also a mobile device: the moment of additional heating can be displaced from one room to another. A family having some extra temperature while eating their meal in the dining room will bring the *remote thermostat* with them when moving to the living room. The device will then automatically adjust the temperature setting the dining room to 'comfort low' and the living room to 'comfort high'. The benefit of the additional log is then following the displacement of the family. In terms of design of the interaction, the *remote thermostat* embodied the extra temperature. The heating system remote control 'is' metaphorically the heating system. And the attention requested to the family to move the *remote thermostat* along with them to take advantage of the remaining time of extra heating participates to the design strategy to recall users attention to energy care.

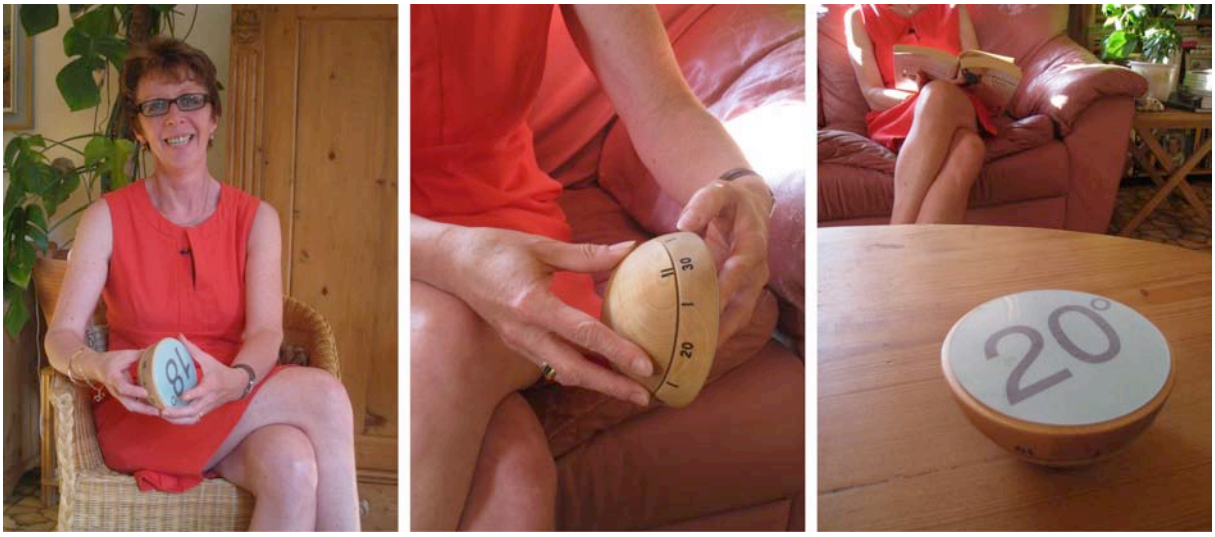

Figure 7 Joelle H. shows how to use the remote thermostat: the heating system is set by default to a 'comfort low' temperature. When standing still, Joëlle sets the remote thermostat for up to 60 minutes of extra temperature turning it like a kitchen timer. When the desired delay expires, the remote thermostat sets automatically back to the economy 'comfort low' temperature.

4. Conclusion: users as experimenters

The conclusions of the specific co-design sessions within the ISEU research project gave rise to 2 levels of benefits:

- the user-centred approach starting from household activities generated very interesting results without any technological improvement of the eco-efficiency of the domestic appliances: only resetting usage patterns by a redesign of existing components 'from the shelf' shows promising propositions in streamlining energy consumption practices of households;
- the very process of the co-design sessions, the progressive training of the families, their involvement in the design of their own future environment brought the research team to consider all the interaction process and the material developed to be used during the sessions between users and designers as a sort of training toolkit to question people domestic practices, to take a distance from them and enable the families to re-invent progressively their daily ways of living.

Beyond concrete propositions for new energy-saving practices, our research has also shown interesting lessons we can learn from the interaction with households.

Our ethnographic approach has revealed that households are much more creative in the way they save energy than the usual representations conveyed by the “rational use of energy” flyers for instance. All the process, particularly the collaborative sessions, shows how much our current thermal regulation systems are often unadapted. When users are given the possibility to imagine other ways of interacting with their heating system, following a

sufficiency principle, they reveal that our houses have embodied standard thermostat systems that do not fit desirable practices anymore.

To observe the willingness of families to play and imagine new devices, we had however to move away from the idea of ready-made products. After the first interview it appeared indeed that the propositions presented as products or services led respondents to a hedonistic situation, like "Would I buy or not?" rather than a change of attitude motivated by a desire to save energy such as: "Is this a good research direction that I can apply?". If there is a reason functioning in this approach, it is not the one of the rational individual seeking to maximize its welfare within a given budget. The co-design sessions showed that participating families are much more in a playful and explorative situation than a pure economic calculation. Families who were ready to play the game, reveal the current system's constraints when asked to turn to energy-saving practices. Experimental situations are transitory, they always end up in final results, in "products". But the process itself is as well interesting as the result. We think that transition towards a sustainable society will require much more transitory experimental situations.

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