Flo: Raising Family Awareness about Electricity Use

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Abstract
In this case study, we designed a family game to explore whether this could be an effective and fun approach for raising the awareness of family members towards their energy use and, in the long run, to provide an effective tool for affecting their habits regarding sustainable behavior. The design of the family game implemented the metaphor of electricity as flowing liquid, fostered fun experiences and supported competitive and social elements. Dutch families with children, aged 5-11 years, participated in the design and evaluation of the concept. We obtained valuable insights into the use and understanding of electricity by the families, how the families looked at responsible behaviors around their usage and how a game could integrate into the family context in a fun way.

Keywords
Sustainability, interaction design, user behavior, family game, electricity use

ACM Classification Keywords
H5.0. Information interfaces and presentation: Miscellaneous.

General Terms
Sustainability, family electricity use

Introduction

Domestic electricity usage in Western countries (such as the Netherlands) has increased steadily over the past decades, in spite of technical innovations in energy saving and rising energy prices [1] [2]. Moreover, research studies to determine intervention strategies that could counter this trend do not typically account for the dynamics of modern families, but rather treat the entire household as a unit of measure. In this study, the focus is on achieving environmental benefits, for example through less electricity waste, by exploiting the possibilities of family activities in which family fun and enjoyment are prime design criteria. A major goal is to circumvent the potential conflict that exists between utility and comfort, where enjoyable activities and comfort at home are not to be compromised, irrespective of their environmental impact. The design of such a fun application for families, which can raise awareness of electricity usage and influence their behavior, requires insights into the relations between the use of energy in the family household and the activities that they enjoy.

Exploring Family dynamics

Brainstorm sessions and focus group methodologies were conducted as well as structured interviews to gain insights in family dynamics, social patterns, fun activities and the general behaviors with regard to energy use and sustainability. Three middle-income Dutch families with young children were selected (each with two parents having 2-4 children, of ages 5 – 11) to participate in the study. Each family received three weekly visits at their home at a time that all family members were present. The major insights with regard to electricity use and family fun and engagement were transformed into the following initial requirements:

- Address the problem of wasteful behavior rather than the saving of electricity (this was a dominant paradigm for saving amongst the Dutch families and was linked to responsible conduct).
- Don't lower the level of perceived comfort in the house (none of the families wanted to compromise on their comfort and entertainment at home).
- Adhere to family dynamics, such as planning and timing of activities and the way they change over time to support joint activities (the families had busy schedules, making it challenging to spend quality time together beyond meal times).
- Provide active, creative, social and educational elements in any fun activity that families entertain together (the parents stated a desire to instil responsible behavior and active lifestyles in their children, whilst the children were curious about environmental aspects and enthusiastically created sketches and models based on what they knew, e.g. solar or wind energy).

These initial user requirements were used to develop design ideas and rank them with the families. The design criteria included: 1) provide fun for everyone in the family, 2) bring the family members together, 3) enable changes in daily life patterns, 4) enable the assessment of wasting electricity, and 5) provide sufficient visualization possibilities to show the use of electricity. As part of the process, the Design with Intent Toolkit [3] was used to frame these aspects in the context of existing eco-design patterns. The most promising design concept was further developed with the families. This concept, "Flo", provides personal, virtual electricity containers that can be used as a currency to pay for the electricity use of entertainment appliances that all family members use. The Flo concept implements the metaphor of electricity as a

flowing liquid. This choice is supported by research on mental models, where people's descriptions of complex systems frequently contain analogical comparisons with simple or familiar systems [4].

The Flo Concept

The goal of the Flo concept is to increase people's awareness of their electricity use and to eventually induce behavioral changes that foster conscious control and reduction of electricity use. The Flo concept has three elements: a docking station, plugs and personal "cubes" (see Figure 1).

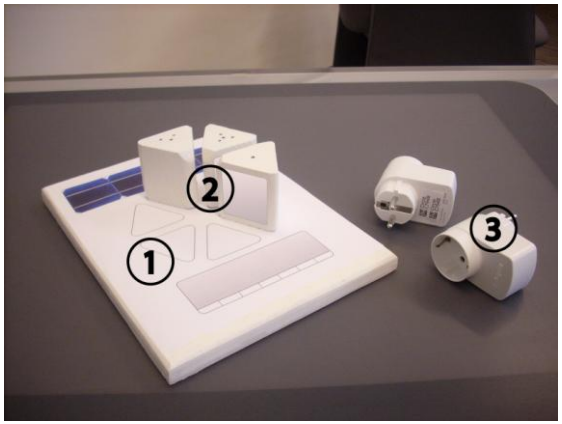

Figure 1. The basic elements of the Flo concept: 1) Docking station, 2) Personal "cubes", 3) Plugs with sensors.

The personal "cubes" are stored and charged on the dock. They display a personal weekly electricity budget. The plugs are connected to electrical appliances in the house and measure their electricity consumption through a built-in sensor. On the dock, the personal "cubes" are stored and charged. Through the dock, users can determine their weekly electricity allowance, which is then displayed on their personal cube. When participants want to use an electrical appliance, they take their personal cube from the dock and when they switch it on, it wirelessly connects to the plug. The electricity use from this appliance is then deducted from their weekly allowance. In order to engage all family members, only entertainment appliances are included, such as, televisions, music systems, personal computers, game consoles. If they use the appliance together with another family member, the costs are split. If they leave appliances on when they are not using them, they not only waste electricity, but also their weekly electricity allowance is used up accordingly. If they run out of their electricity allowance, they can negotiate with their family members to do something in return for exchanging an extra allowance from them. These activities can be used as a family competition, because at the end of the week, the one who uses least is the winner.

Concept Refinement

A video describing a typical week of playing Flo was made to show its usage to the participating families and to see how it could fit within their home context. The oldest child from each family first viewed the video and then described it to the other family members. This helped us identify aspects that were important to them and were easy to understand. The family then viewed the video together for discussion. From this, the most salient aspects were: the desire to get more detail from the visualization (e.g. to switch between daily and weekly views, show exact measurements), to see who is ahead in the game, the possibility to set goals for electricity allocations (for example, assigning the same limit for everyone, providing personalized limits and setting long-term goals). For parents, the awareness of electricity consumption was the essential aspect of the

Flo concept, but for children, it was the competition and fun aspects of the game strategy. Parents appreciated that their children were given the responsibility to monitor their energy usage patterns and that it might motivate them to use their computers less and become more physically active. This feedback was used to adapt the Flo concept by including an "energy-slurping monster" to further exploit the "energy as a liquid" analogy (Fig. 2: monster mat). The mouth of the monster is linked with a plug to an electrical appliance and activated by placing the personal cube on the monster mat. The flow of liquid from the personal cube to the monster represents the electricity flow. A fish is added as a persuasive element to create a personal and emotional bond between the persons and their "cubes" or energy allocations and to maintain a sufficient liquid level for the fish to survive and be happy. Finally, a "watering can" is provided to "pour out" weekly quotas.

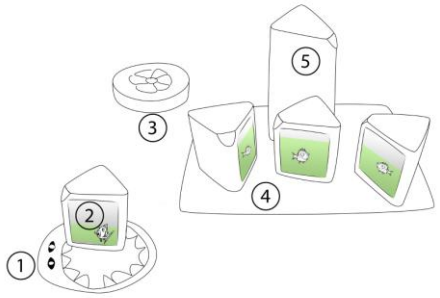

Figure 2. Flo-2 concept: 1) Monster mat, 2) Fish animation, 3) Generator, 4) Docking station, 5) Watering can.

If the electricity quota goes down, the fish will have less water to swim in, and eventually will disappear into the monster's mouth. This is presented on the display of the docking station to provide an extra incentive to keep the water level high enough for the fish to survive. Finally, a generator was included to provide extra electricity (and keep the fish happy) by physical activity.

Concluding Remarks

The Flo concept implements different factors in a family game which could provide awareness of electricity usage in a way that all family members could engage in to support behavior change. These factors are: the use of self-monitoring mechanisms, behavior conditioning techniques, the use of metaphors, selective use of scarcity, and affective engagement. The border between saving and not wasting electricity is thin and dynamic as it also depends on behavioral changes over time as a function of family development. To achieve a sustainable reduction of electricity use in the household without having to forgo on fun and comfort remains a challenge requiring further exploration, formal evaluations and long-term field testing of prototype implementations with other samples of the population. Furthermore, this approach could be explored for other application domains where behavioral change is desirable.

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