Designing a Smart Phone App for Sustainable Cooking

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Abstract
This research is focusing upon the human-computer interaction (HCI), evaluating the relationship between users and cooking appliances mediated by information-communication technologies (ICTs) applications designed specifically to motivate energy saving. User observation, energy monitoring and semi-structured interviews helped to understand user behaviours and its respective determinants. Group discussions and large scale surveys were used to evaluate the acceptance of energy saving techniques and intervention methods. This knowledge informed the development of a persuasive electronic energy saving intervention in the form of a mobile phone application, which is being tested.

Author Keywords
Persuasive technology; behaviour change; cooking appliances; energy saving; mobile phone application

ACM Classification Keywords
J.4 [Social and Behavioral Sciences]: Psychology; H.5.2 [User Interfaces] Evaluation/Methodology, User-Centered Design; D.2.2 [Design Tools and Techniques]: Miscellaneous

General Terms
Measurement, Performance, Design, Experimentation, Human Factors, Verification

Introduction

The design of products and services can influence how we behave and ultimately contribute towards minimizing the negative environmental impact of energy consumption [3]. This research is looking at ways of reducing energy use on existing cookers through behaviour change without involving replacement of existing appliances and not considering the embodied greenhouse gases from ingredients [5]. In the field of Sustainable HCI, it is possible to list examples of research demonstrating how ICTs applications can be designed to influence energy consumption [17]. Although previous research show the potential impact of technology in promoting energy conservation, they also indicate the need for more research in this field, especially regarding user acceptance and tolerance of persuasive methods implemented [7].

From Fogg's [9] list of common uses of persuasive technologies as tools, it is possible to exemplify how they could be embedded within a persuasive intervention intended to influence people's behaviours whilst cooking [13]. A number of studies report the use of ICTs as assistants for cooking, trying to improve confidence [11], skills [16] or usability [4]. It is understood that the cooking activity places challenges upon the use of electronic interventions. Human-food interaction involves uncertainty, experimentation, creativity and fun. The introduction of *corrective* technology must be done with care [10]. Researchers should carefully determine when to introduce technology, to make sure that it is indeed needed, or to guarantee that it is not going to cause more harm than good [2].

Methods

A user observation study was performed with 20 participants to understand the key energy related behaviours and what are the determinants of these behaviours associated with cooking. A set of energy saving techniques were developed, based on the user observation study, together with the literature about how to cook using less energy and also based on a series of experiments that simulated the cooking process to understand the most efficient way to cook the same food[14]. The next step of this research was an online survey with 240 participants based on the Theory of Planned Behaviour – TPB [1] to evaluate the acceptance of these proposed energy saving techniques. This knowledge informed the design of an electronic intervention to reduce electricity consumption while cooking. The final stage, being carried out at the moment, involves the evaluation of this intervention.

Results

Data analysis from the user observation study showed surprisingly diverse user behaviours, time to complete the task and electricity use. When asked why they undertook specific behaviours that resulted in extra energy usage, their explanations were mainly related to minimizing preparation time, convenience, habit and personal preferences [12]. These results were compared with best practices showing that the average user expends 3 times more energy than one following a few simple recommendations. The observations also demonstrated ergonomic problems during the interaction with the cookers, and a lack of knowledge on how the available appliances behave [14].

The TPB study involved the evaluation of 7 proposed energy saving tips for cooking. Participants were asked to rate their attitudes, social norms and level of control related to these techniques, and also intentions to perform these behaviours.

The proposed intervention

Results from the studies performed during this research indicate that participants cooked food for longer than needed, even though they wanted a quick result. This knowledge suggests that the proposed intervention must help them act on their intentions. One negative aspect of measuring the time, according to participants' beliefs, is that it can add effort to the cooking activity. However, it can be seen as an opportunity to facilitate the process by presenting a timer embedded in an application. The proposed mobile phone application facilitates the time management by providing the information needed to carry out the intended behaviour [8].

Participants attempted to speed up the cooking process by not measuring the amount of water, boiling the kettle, using bigger hobs and keeping high heat until the end of the process. It indicates that there are 2 occasions of temporal tensions, as suggested by [15]. First, participants rushed into cooking without much deliberation. Then, they tried to speed up the process in order to minimize the boredom when waiting, at the cost of extra energy usage. One possible way to avoid these tensions is to improve the *flow* of the activity [6]. The intention is to manipulate time perceptions by fostering the concept of flow towards a more enjoyable cooking process. By matching user capabilities and environment demands, it might be possible to avoid boredom or anxiety and increase the acceptance of the application. But the exact effectiveness of an intervention in terms of improving the user experience for an everyday task like cooking, increasing flow and reducing energy usage at the same time is still uncertain. This is the focus of the current research.

Conclusion

During this research it was observed that participants behave in diverse ways, even if cooking a rather simple meal, using the same appliances and same utensils. Consequently, the electricity usage and the time to complete the task vary remarkably. Another observation is that participants rarely followed recommended best practices, often because of lack of knowledge, because they wanted to cook quickly, due to convenience or habit. A persuasive intervention that manipulates the perception of time could be helpful to steer their behaviours towards a more efficient cooking process, leading ultimately to energy saving and sustainability. The success of such application is currently being assessed, specifically regarding the effectiveness of the time perception manipulation concepts embedded in the application, and the acceptance of an ICT enabled cooking assistant to motivate sustainable behaviour. This research also hopes to contribute to the knowledge of time perception manipulation and develop a set of guidelines intended to facilitate the design of future ICT based interventions targeting behaviour change.

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