

Persuasive games to stimulate sustainable energy consumption

Jan Dirk Fijnheer^{1,2}, Herre van Oostendorp¹ and Remco C. Veltkamp¹

¹Department of Information & Computing Sciences, Utrecht University, Utrecht,
The Netherlands

²Inholland University of Applied Science, Diemen, The Netherlands
{J.D.L.Fijnheer, H.vanoostendorp, R.C.Veltkamp}@uu.nl

In this position paper we explain our perspective on how to influence sustainable household energy consumption. In the final part of this position paper we describe research questions that need to be answered to bring the field a step further.

Persuasive games and gamification can be an effective means to change people's energy-related attitude (Fijnheer & van Oostendorp, 2015). When people are highly engaged in the game they are apt to adopt the attitude that is promoted in the game (Rugiero, 2013). This can lead to a higher awareness of relevant factors involved in, for instance, energy saving. In effect, attitude may positively change and as such, subsequently trigger a change in energy saving behaviour itself. The assumed chain of events awareness (knowledge) - attitude change - behaviour change is what persuasive games try to influence (Aronson et al., 2013; Chen & Chaiken, 1999; Soekarjo & van Oostendorp, 2015). Gamification by incorporation of game features can be a valuable strategy for making non-game products, services, or applications, more motivating, and/or engaging the user (Deterding et al., 2011).

For our research project *Powersaver Game* is designed. Families will play this game for two months in their own household. The main goal is to reduce energy consumption. A system without game features providing feedback can decrease the energy consumption of households by fifteen percent (Darby, 2006). Every other day energy saving missions are provided by the game. Behaviour in real life, by means of electricity and gas use of the household, is integrated into the gameplay. A real time connection between the household energy meter and game server is accomplished by dataloggers with an Internet connection.

We have followed a "considerate user-centered" game design methodology including two design phases. In the first design phase we have formulated goals the game should meet. These goals concern effects of the game such as awareness, information transfer and behaviour change and involve game characteristics such as integration in real life, duration and storyline. In related work the design features and empirical effects of games that are used for similar research, are reviewed. The empirical effects of these games in changing knowledge, behaviour and attitude are all positive. Most effective features reported are competition, team play/social component, rules of play and feedback. Also, household energy saving missions have been delineated in this step. Based on a novel gamification process real life activities related to energy consumption are incorporated in the game design. Gamification by implementing these real world processes in game design is still an emerging principle in research and represents a very important step to optimize the transfer of knowledge between the

game world and the real world in order to change attitude and behaviour. In the next design phase potential players evaluated the implementation of household energy saving missions as well as the complete design.

In the first experiment planned, a "media comparison" study (Mayer, 2011) - answering the question whether people learn better from a game or conventional media - , families will play the game or use the energy dashboard version in the control condition. The form, timing and content of the information the control condition receives are as similar as possible as in the game condition, but excluded game elements. Next, in a "value added" approach (Mayer, 2011) - answering the question which features of a game promote learning - the effects of the features feedback (minimum versus maximum information), personal relevance (by means of customized avatars, activities, goals and feedback) and social interaction (by means of competition) on knowledge, attitude and behaviour with respect to energy consumption are examined.

To conclude we think there should be more attention on empirical studies that

- are conducted over a longer period of time,
- can measure changes in knowledge, attitude and behaviour, also after delay,
- include adequate control conditions.

The following research questions need to be answered to bring the field a step further:

1. Which (persuasive) features of a game promote lasting changes in knowledge, behaviour and attitude regarding sustainable energy use of households?
2. Do people become more aware of energy consumption related determinants from a persuasive game or conventional media, or even compared to a simulation and change more in attitude and behaviour?
3. What is the effect of implementing real life elements in a game compared to simulations, more specifically, how to optimize the transfer between the game world and the real world?

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