GREEN TALK: USING DIGITAL VOICE ASSISTANTS FOR MORE EFFICIENT ENERGY CONSUMPTION IN FAMILIES

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ABSTRACT
Smart meters convey information on energy consumption to raise people's awareness and lead to reflection about energy use. However, studies show that after a short period of time, people lose interest in the information displayed on smart meters. Smart meters are typically designed for motivated individuals in full control of their household energy use, but research indicates differing levels of engagement and motivation. Moreover, focusing on the individual overlooks the complexity of family households: there is a need to focus on families as the key unit of analysis and to better understand the use of smart meters, by investigating different roles and responsibilities in households.

Problem statement

How do digital voice assistants (VAs) can be used to foster dialogue in the family and to motivate family members to engage with energy consumption information, negotiate reduction goals and come up with solutions towards energy consumption efficiency?

Background and relevant work

The goal of reducing resource consumption in households is at the centre of environmental policies. Various eco-feedback technologies targeting a domestic setting have been developed to support these policies. However, studies of energy feedback applications, such as smart meters, are disappointing: after a short period of time, people lose interest in the information displayed, with relapsing effects (Froehlich et al., 2010; Hargreaves, et al, 2010; Hazas et al, 2012; Pierce et al., 2010; Strengers, 2011; Pereira et al, 2013). Smart meters are typically designed for individuals who are envisioned to be highly motivated and in full control of their household energy use. However, research shows differences in the ways in which users adopt them (Strengers, 2011, 2014; Hargreaves, Nye and Burgess, 2010), with differing levels of engagement and motivation, and subscription to different norms

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and attitudes with regard to conservation (Bertoldo et al., 2015). Research also highlights the need to focus on families as the key context for analysis to further develop supporting technologies and better understand their uses (Hargreaves et al, 2010; Dillahunt and Mankoff, 2014, Barreto et al 2013; Neustaeder, Bartram and Mah, 2013). Different forecasting models have been employed (e.g. Lazzari et al , 2022) to model expected user behaviour based on past consumption.

Moreover, most households are composed of families with children with various roles and responsibilities regarding the use of resources. In this respect, research needs to look at how smart meter enabled applications are viewed by both parents and children, how different members of the household/family negotiate roles, participate in decision-making and are involved in a variety of home activities affecting energy consumption (Riche, Dodge, & Metoyer, 2010; Barreto, M., Karapanos, E., Nunes, N., 2013). In this context, a central challenge is to increase households' interest and engagement with information about energy consumption conveyed by smart meters and sustainability goals.

This research will explore and validate the potential of the recent widespread interest in digital voice assistants (VAs) such as Amazon's Alexa to promote active conversations about energy consumption and reduction within the family (see, for example, Gnewuch et al. 2018, Giudici et al. 2022, Sadek et al. 2023). We believe that these conversations around energy issues will boost understanding and reflection around energy consumption and promote concrete activity towards energy efficiency. Beirl, Rogers, and Yuill (2019) and Sciuto et al. (2019) showed that families are incorporating conversational agents' technologies in their current digital tools ecosystems. Their findings suggest that families developed new rituals around VA features, and these new rituals contribute to social and emotional bonding and family cohesion. These results are relevant for our research insofar as they show that families develop specific practices around VAs, and these practices, in turn, serve to stimulate conversations and reflection regarding energy efficiency.

Methods

The research involves 3 distinct steps.

Step 1, initial deployment of a VA in households and collection of data concerning the use of smart meters. In terms of methods, we will collect logs of the VAs to see how this technology is adopted in homes (the logs are to be approved by the participating families before being released for research). We will also use questionnaires to the households inquiring about the ways they use the smart meters and collect data regarding the actual consumption of energy in the households.

Step 2 concerns conducting participatory design and user-centred design approaches with the families. The methods to be use include initial interviews with the participating households to gain knowledge about the family dynamics and their use of digital technologies. After, the family-based design sessions will actively engage with the participants in creating prototypes that encapsulate the main design

ideas. The workshops will be recorded (given participants' consent) and the outcomes of the sessions will be analysed within the design team.

Step 3 concerns the actual intervention/deployment and evaluation. In terms of methods, we will have the deployment of the VA prototype in the homes of participating families and the data collection of energy. Furthermore, questionnaires and interviews will be conducted to explore in more depth how the VAs were used and the actual motivations and reasons why certain behaviours are changed or maintained. Finally, the analysis of the Alexa logs – recording of Alexa conversations. The participants will be asked for consent regarding the recording of Alexa's logs and the logs will be subject to approval by participants.

Expected contributions and conclusions

Our project will pursue three distinct goals. First, we will develop an analytical framework that allows the description and identification of distinct household practices around the smartmeters. This will enable us to investigate how households understand resource conservation, identifying which norms and attitudes guide this understanding. Second, we will investigate whether and how the use of smartmeters is negotiated in the family and whether and how such negotiation influences the setting of common goals and energy conservation in the home. This knowledge will contribute to the current understanding of the potential role of the VA as a promoter of reflection about energy efficiency, and as a mediator in the use of smartmeters. Third, we will be involving households in the design process of a VA following a participatory design approach. This approach will elicit information about VA use and understand families' specific circumstances, behaviours, and needs. This approach will also allow understanding, from the way the different households engage with the design process, their likes and dislikes, and barriers to adoption.

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