



## Original research article

Does it last? Long-term impacts of an app-based behavior change intervention on household electricity savings in Switzerland<sup>☆</sup>Devon Wemyss<sup>a,\*</sup>, Francesca Cellina<sup>c</sup>, Evelyn Lobsiger-Kägi<sup>b</sup>, Vanessa de Luca<sup>d</sup>, Roberta Castri<sup>c</sup><sup>a</sup> Center for Innovation & Entrepreneurship (CIE), Zurich University of Applied Sciences (ZHAW), CH-8401 Winterthur, Switzerland<sup>b</sup> Institute of Sustainable Development (INE), Zurich University of Applied Sciences (ZHAW), CH-8401 Winterthur, Switzerland<sup>c</sup> Institute for Applied Sustainability to the Built Environment (ISAAC), University of Applied Sciences and Arts of Southern Switzerland, CH-6952 Canobbio, Switzerland<sup>d</sup> Laboratory of Visual Culture (LCV), University of Applied Sciences and Arts of Southern Switzerland, CH-6952 Canobbio, Switzerland

## ARTICLE INFO

## Keywords:

Energy consumption  
 Behavior change  
 Gamification  
 Long-term impacts

## ABSTRACT

While various approaches are shown to be effective in reducing electricity use of end consumers during an intervention, few studies continue to track participants to evaluate whether these effects last and whether the same factors are still impactful in the long term. The present paper describes results one year after a behavior change intervention, called Social Power, aimed at reducing household electricity consumption using a gamified mobile application connected to a household's smart meter. Between February and May 2016, forty-two households in two Swiss cities were actively involved and monitored along with corresponding control group of forty households. The intervention engaged app users in a neighborhood challenge to complete electricity saving activities and realize their progress through electricity use visualization. One year after the intervention, electricity consumption was measured, and follow-up online surveys measured reported behavior and perceived injunctive norms of the participants. During the intervention, participants significantly reduced their electricity use, with respect to both historical consumption and the control groups. However, after one year it was found that the electricity savings achieved during the intervention were not maintained. In contrast, the participants reported their behavior as more efficient compared to before the intervention and still perceived the impact of the intervention in their community. This counter intuitive relation between the three measured variables is discussed, along with possible strategies to maintain the positive effects achieved in the short-term.

## 1. Introduction

A reduction in total electricity demand often accompanies renewable energy development in national energy strategy policies [1]. While reducing the total electricity use can result from the implementation of more efficient technologies, decreasing wasteful consumption of resources via behavioral change is an additional measure [2]. For a successful and persistent change in behavior to occur, a supportive contextual setting, which can be created through an intervention, can facilitate this change [3]. Thus, many intervention studies assess the effectiveness of different motivational triggers with varying degrees of success when measured directly after the intervention [4–7].

However, without an evaluation of whether a successful program (as measured in the short term directly after the intervention) also maintains the newly developed sustainable behavior at least one year after the intervention, the overall effectiveness of the intervention is

difficult to ascertain. A lack of understanding of long-term effects is particularly critical when trying to meet energy reduction targets [8,9].

## 1.1. Persistent behavior change

There is a long tradition of research on influencing factors for pro-environmental behavior [10–12], and there are a few well-recognized models and theories which help to explain that individual behavior is not only driven by rational or purely economic decisions [13]. Furthermore, while information campaigns, without additional mediating factors, may change attitudes, this remains at a highly rational level and is insufficient to translate into practice - the so-called Value Action Gap [11]. Sociology and psychology have contributed meaningful models here that help to define the origin of behaviors, and aim to change the behavior by adjusting antecedent factors.

For example, from psychology, the Theory of Planned Behavior [14]

<sup>☆</sup> This work was supported by Gebert Rüf Foundation under the BREF program in the field of Social Innovation, grant GRS-065/14.

\* Corresponding author.

E-mail address: [wemy@zhaw.ch](mailto:wemy@zhaw.ch) (D. Wemyss).

argues that perceived control and self-efficacy are important precursors to the intention to act. The Value-Belief-Norm (VBN) model [15] takes this concept a step further, by considering the external social context wherein the action takes place and thus discusses how individual beliefs play a mediating role between values, norms and ultimately behavior.

Further acknowledging the social context, social norms are a widely-used approach because of their power to guide individual action in meaningful ways through social comparison [16]. We can distinguish between descriptive norms (information about how other people behave) and injunctive norms (perception about how other people would like you to behave). Both of them have been found to impact a change of behavior in the short term [17,18]. However, a descriptive norm can have a boomerang effect on individuals who already act in a more desired way than the descriptive social norm defines. In this case, if the descriptive norm is complemented by an injunctive norm which supports the behavior, the boomerang effect may be buffered [16]. Thus, there is the expectation that the existence of injunctive norms can help maintain a desired behavior in the longer term.

In the field of demand-side management (DSM) in particular, much attention has been given to technological and economic factors which approach behavior change more from an individualistic perspective, neglecting as such the social context [19–21]. Other lines of research, however, acknowledge the importance of social and cultural factors in defining a context for embedding behavior [10]. Social Practice Theory [22], for example, considers what activities are relevant to motivate a change of individual habits favoring pro-environmental behaviors, as compared to only improving technological efficiency. For example, the theory draws attention to routines, such as cooking, showering, and washing, that are impacted by social factors, and for whom collective organization plays an important role [23]. As a consequence, DSM projects are now increasingly being designed and developed as to no longer approach consumers simply as individual agents for change, but rather as socially embedded actors, thus leveraging on collective dynamics and shared values and goals [24].

Deviating from more linear models of behavior, other researchers have developed models which incorporate iterative factors that reinforce more sustainable habits or, on the other hand, can instigate a potential change in habits when used as a disrupting force in an intervention [11,25]. The phase model for behavior change proposed by Bamberg [26] and further developed by Ohnmacht et al. [27], describes the dynamic process which occurs before a new action is taken, as well as the potential relapse to prior behavior. In the post-actional stage, the statement of positive consequences and social support could help maintain the intended behavior over time [26]. Furthermore, it could support returning to the intended behavior in case of an occasional relapse into old behavioral patterns and habits.

Within these theories and subsequent approaches, only a few studies have analyzed long-term effects. In their study about setting up household smart energy monitors, Hargreaves, Nye and Burgess [28] reported that the long-term effect of a feedback-based energy saving intervention was little. Instead, encouraging long-term effects on electricity savings were shown in a socially-embedded energy efficiency program in the Netherlands [29]. Anderson et al. [30] also found a positive effect on the durability of energy behavior change, when normative feedback messages were continued over time. Schleich et al. [31] combined in-home displays of electricity use with feedback and realized significant savings in those households over an 11-month intervention.

### 1.2. Gamification

A further emerging field for capturing attention and keeping people engaged on sustainability topics is gamification [32,33]. While the definition of gamification is still evolving [34], in this study it is understood as the incorporation of game design elements, such as points, leader boards, levels, narrative or time constraints, into non-game, *i.e.*

not solely for entertainment, contexts [35,36]. The potential lies in the motivation and emotional association created by the gamified setting for both pleasure and educational topics, or those of societal importance [37]. As in the previously mentioned behavior change interventions, few gamification studies have looked at the long-term maintenance of a positive behavior change [32]. However, Nicholson [38] argues that long-term effects can be better achieved through means other than reward-based mechanisms, such as providing information and giving a choice. The action/feedback cycle, in turn, influences learning through enhanced engagement. On the other hand, reward-based gamification can be useful to engage people where there is no existing personal or emotional connection – which is often the case with electricity use. Thus, both reward and non-reward based elements are applied in the design of the study presented here, which aims at shaping long-term effective electricity saving interventions.

### 1.3. Aims and hypotheses

This paper focuses on the long-term impacts of a three-month intervention study run in Switzerland in 2016, called Social Power. The study exploited social norms, gamification, feedback and a smartphone application (app) to encourage electricity savings in households. It has been shown elsewhere [39] that the intervention resulted in significant electricity savings of the active participants compared to their historical data and to the control groups, as well as improved self-reported behavior and injunctive norms. Here, the focus is on whether this behavior change is maintained one year after the intervention. Thus, comparing data collected before the intervention and one year later, we test the following null hypotheses:

- H1.** After one year, the average weekly electricity consumption has not significantly changed with respect to before the intervention and compared to the control group.
- H2.** After one year, reported behavior has not changed with respect to before the intervention.
- H3.** After one year, injunctive norms have not changed with respect to before the intervention.

After describing the design of the intervention and the smartphone app designed for the study, we present the analysis methodology and results obtained one year after the intervention ended. The final discussion compares long and short-term effects and suggests possible strategies to increase enduring effectiveness over time.

## 2. Intervention design

Effectiveness of the Social Power app is tested in a behavior change intervention study: a real-life trial run in two cities in Switzerland with the aim to assess the impact on electricity consumption of household members participating in a gamified, digital, app-based community challenge designed to trigger electricity savings. Both of the cities had installed smart meters and were interested in experimenting with the added-value of the collected data, however they had not previously used their smart meters for a behavior change intervention.

### 2.1. Experimental set-up

In September 2015, 108 households voluntarily took part in the study ( $n = 54$  in Massagno, city 1, and  $n = 54$  in Winterthur, city 2). Recruitment occurred by means of an open call to the public and direct mailing from the local electricity provider to their household customers. Monetary incentives were given to improve uptake: participants were part of a final draw to win one of three vouchers of approx. 700 Euro value sponsored by the two local electricity providers. This draw was open to all participants who remained active until the end of the intervention.

Download English Version:

<https://daneshyari.com/en/article/8959805>

Download Persian Version:

<https://daneshyari.com/article/8959805>

[Daneshyari.com](https://daneshyari.com)