INATTENTION AND MISPERCEPTION OF SMART METERING SERVICES: Evidence from Field Experiment

Miyeon Jung, KAIST College of Business, Republic of Korea
+82.10.4017.4587, hoya0604@kaist.ac.kr
Daegon Cho, KAIST College of Business, Republic of Korea
+82.10.3129.6442, daegon.cho@kaist.ac.kr

Overview

Advanced information and communication technologies allow us to record and monitor our everyday life without even being noticed. It provides a setting to better understand routine activities and change behaviors in desired directions. In this regard, residential energy has recently become a fertile field of research by which the smart meter technology has enabled real-time recording of water, gas, and electricity usage, and driving us to more efficient life.

There have been ample studies of smart metering in a multi-faceted approach, and mainstream of the literature focuses on energy saving-related topics. Specifically, previous studies have proposed effective information designs to motivate their engagement under the settings of either field experiment or survey. However, it was difficult to precisely capture how much users engage in the service and how the user characteristics play a role in the behavioral changes led by the engagement when the interventions are placed in the real world. To fill this gap, this study utilized both a series of surveys and a field experiment for the smart meter customers with a collaboration of the largest smart metering service provider in South Korea.

In fact, smart metering services equipped with a mobile application in the personal setting allow us to investigate the monitoring and energy-use behaviors of customers at the individual level with greater detail. By doing this, we examine the relationship between smart metering service use *and* psychological perceptions, offering. Specifically, according to the literature, we divided the engagement process of smart metering services into three phases – i) mobile application access, ii) information processing, and iii) energy consumption decision.

In the pre-treatment observation period, we found primary biases for each phase: inattention (mobile application access) and misperception of the bill (energy information processing). It appeared that the majority of the users do not pay attention to the given energy monitoring application. To address these contradictory biases and achieve energy saving, we designed and implemented a framed field experiment, which is a campaign-like energy-saving program for the participants of this study. During this intervention period, we sent two types of mobile messages to different treatment groups every week: a goal setting of the achievable bill and weekly usage feedbacks.

Our results suggest that the number of users who access the mobile app was doubled with the intervention. In addition, customers in the treatment group who receive the combined information of a goal setting and weekly feedback significantly reduced their energy usage, compared to customers in other groups. However, the goal setting of the achievable bill information alone did not lead to the noticeable behavioral change of energy use.

Indeed, there were sufficient variations in terms of monitoring and energy-use behaviors across users. In other words, the message interventions do not have an equal effect on the engagement and energy consumptions that are associated with the underlying mechanism – attentions, psychological perceptions and the actual behavioral changes. By making sense of energy consumption behaviors and responses to energy-saving campaigns from a comprehensive perspective, our study may provide useful implications to policymakers who design energy-saving programs and industry practitioners who develop business strategies. To the best of our knowledge, this is a pioneering study examining the effect of smart metering services in the mobile app setting.

Methods

The future smart meter research is more likely to involve the use of a mobile app, not an in-home display (IHD) as a primary information channel, so energy monitoring and saving actions can be observed separately. In other words, under the IHD settings, the monitoring behavior that acquires information was not tracked and recorded in the previous studies. In this study, we however can collect each user's mobile app access behavior on a daily basis and energy consumption information every 15 minutes, which is a more advanced framework. We designed and implemented a field experiment that introduced campaign-like energy saving intervention to a sample of smart metering service users. The field experiment, consists of a pre-survey, campaign-like intervention, and post-survey. The pre-survey was conducted before the experiment, and the main campaign-like treatments are placed in August

2017. We sent intervention messages up to six times for each user, with the number and the content of messages differing across the assigned group.

Participants

To be eligible for the participation in the field experiment. we recruit households who are currently using the smart metering service with the installation of the energy-monitoring app. By sending a link to connect the campaign participation page to each subscriber's smartphone, 301 households are formed as a sample of this study and were randomly assigned to three groups: the control group (61), who had smart meters and received energy saving tips; the treatment 1 group (120, "goal-only"), who, in addition to the saving tips, received achievable goal; and the treatment 2 group (120, "goal+feedback"), who, in addition to the saving tips and goal information, received weekly feedback.

Data

We used high-frequency meter data on household electricity usage as the primary data source. Advanced meters were already installed in all participating households, enabling electricity usage of all participants to be collected at 15-minutes intervals. As a unique point of our study, we also collected the mobile application access data for all households. The mobile application access data was acquired at the day level because the database system only provides the data for recent access dates, not all points of access. Therefore, we manually accessed the mobile database system of the company, and downloaded the recent access data at least twice per day. The download times are between 9–11AM and 6–8PM to catch the day-level access as accurately as possible.

We rely on data collected from two surveys: one prior to the assignment to treatment and another upon completion of the campaign. These surveys collected data on demographic and household characteristics, bill perception, mobile app use, etc.

Results

What accounts for low energy saving achievement of smart meter users in pre-treatment period?

1. Inattention to mobile app: the relation between mobile app use and energy consumption shows U shape. The users who access the app less consume more electricity than others do. However, the users who access the app very frequently also consume more electricity. That is, the inattention to smart meter app is one of the reasons of low energy saving achievement, but the user who access the mobile app frequently also could not achieve high energy saving.

2. Misperception of the bill: we hypothesized that the user, who perceived their bill not correctly, satisfied their energy behavior early or give up changing their energy behavior. In our analysis, the users who have bill misperception consume significantly more energy than rightly-perceiving users.

Treatment effects on accessing mobile app and energy consumption

1. Mobile app access: the average number of users who access the mobile app per day was doubled under the intervention. That is, external push messages (passive information push) can encourage the mobile access (active information searching).

2. Daily energy consumption: We employ econometric models to explore the average effects of providing the goal or weekly feedback with the goal for the campaign period. We run a panel regression using a difference-in-difference specification. It was clear that Goal+Feedback information has a statistically significant effect.

Conclusions

We study energy consumption in response to a messaging campaign, and provide some of the first evidence on the different perspective to understand users' energy behavior. Our main finding suggests that information delivery of current smart metering services may need to be improved, and more active interventions can encourage both of energy monitoring and saving behaviors to some extent. The experiment demonstrates that weekly feedback with goal-setting information can change energy consumption behaviors.

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