GREEN IS DESIGN AND ENERGY CONSERVATION: AN EMPIRICAL INVESTIGATION OF SOCIAL NORMATIVE FEEDBACK

Completed Research Paper

Claire-Michelle Loock
Swiss Federal Institute of Technology
Information Management,
Scheuchzerstrasse 7, 8092 Zürich,
Switzerland
cloock@ethz.ch

Thorsten Staake
Swiss Federal Institute of Technology
Information Management,
Scheuchzerstrasse 7, 8092 Zürich,
Switzerland
tstaake@ethz.ch

Jan Landwehr
University of St. Gallen
Center for Customer Insight
Bahnhofstrasse 8, 9000 St. Gallen,
Switzerland
jan.landwehr@unisg.ch

Abstract

A combination of information systems and socio-psychological concepts holds the potential to exert a positive influence on the energy consumption of individuals. In a field study among 9,929 users, we investigate whether descriptive and injunctive normative feedback lead to significant effects on energy demand if delivered by a website have the same effects as when delivered via personal interaction as in Schultz et al.'s (2007) study, and whether both feedback types have different effects on repeated voluntary system usage. We found a similar pattern with respect to energy consumption as did Schultz et al. (2007) based on personal interaction, and no difference with respect to frequency of system usage. The findings are important for the design of information systems that utilize feedback concepts to induce a sustainable energy usage among households. Ultimately, the results support utility companies and policy makers to cost-effectively meet regulatory saving targets.

Keywords: Green IT/IS, social norms, sustainability, social presence, empirical study

Introduction

Against the background of the steadily increasing global hunger for energy (OECD 2006), carbon dioxide emissions and resource depletion have become major concerns in our society. Business organizations play a critical role in promoting environmental sustainability because they contribute to a significant share of worldwide energy consumption themselves (IEA 2008) and also exert influence on consumer choice due to their dominance in the global economy (Melville 2010). As a consequence, firms are increasingly made accountable for their actions not only in terms of financial performance but also regarding their environmental and social responsibilities (Elkington 1997; Butler 2011). In the context of corporate responsibility, technology is both a cause of the environmental burden (due to the resources that need to be invested) and a potential solution (due to efficiency gains) (Watson et al. 2008). Information and communication technology may be instrumental in fighting the negative environmental effects of the world's rapidly developing economies (Erek et al., 2009), but it is also responsible for a significant share of energy and resource consumption itself. Given the ambiguous role of information and communication technology (ICT), the information systems (IS) research puts a varying emphasis on either mitigating the technology's negative environmental footprint or on strengthening the beneficial effects in terms of increasing energy efficiency in operations. Under the notion of 'Green IT,' firms and researchers traditionally place a focus on information and communication technologies as a cause of environmental concerns (Murugesan 2008). Research in this area concentrates on hardware design and implementation issues, with the aim of improving energy efficiency of data centers, minimizing the ecological footprint of IT, and reducing the impact of electronic waste (Bengtsson & Ågerfalk 2010; Dedrick 2010; Mithas et al. 2010; Jenkin et al. 2011a).

More recently, research has shifted the focus from Green IT towards the intelligent use of IS because it holds the potential to establish sustainable practices across all functions of the organization (Watson et al. 2010). The scope of the Green IS movement encompasses improvements in the eco-efficiency of business processes through automation, the development of more sustainable strategies with the help of decision support systems, and an overall improvement of environmental information flows in the organization, among others (Thambusamy & Salam 2010). Whereas the majority of Green IS studies are at the organizational level of analysis (Jenkin et al. 2011b), few studies address the application of Green IS for motivating individuals to be energy efficient. However, some researchers already emphasize the role of IT in exerting a positive influence on the beliefs and behaviors of individuals, whether they are employees or consumers (Bottrill 2007; Froehlich 2009; Holmes 2007; Mankoff et al. 2007). The endeavor to address consumer behavior is especially promising because energy consumption is highly dependent on consumer choice and habits (Dimitropoulos 2007), while, at the same time, domestic energy demand in Western countries accounts for 20% to 30% of total energy use (EEA 2001; EIA 2009).

To promote energy savings, it seems appropriate to combine research on IS with concepts from psychology to engage consumers in energy conservation activities. This approach follows Allcott's and Mullainathan's (2010) call for action, published in Science, to use engineering approaches to translate "behavioural science insights into scaled interventions, moving continuously from the laboratory to the field to practice." The literature on probing the effects of the multitude of interventions investigated in psychology (mostly laboratory studies) in scalable information systems, however, is sparse. Prior works have usually been limited to technological aspects, sometimes complemented by small-scale user studies over a short period of time (e.g., Froehlich 2009; Shiraishi et al. 2009). Moreover, existing studies in the psychology literature expose subjects to interventions and monitor the effects on a dependent variable. While these experiments are insightful, they do not explore whether the interventions have an effect on repeated, voluntary exposure to the interventions. Thus, they do not shed light on their applicability in Information Systems that rely on repeated, voluntary system usage. In other words, some interventions might be effective only once, and users abstain from being exposed to feedback in the future.

In this paper, we present an energy efficiency website ("Velix") that serves as the basis for a campaign with an Austrian utility company and provides customers with feedback on their electricity consumption. Utility companies play a very special role in promoting energy efficiency because their revenue typically increases when their customers use more electricity. However, recently introduced policies intend to decouple utility profits from sales and require the companies to implement and credibly document energy consumption reductions (Kushler et al. 2008). As a consequence, utilities are incentivized to introduce effective energy conservation programs that reach a large proportion of their customers. IS in this context is regarded as an enabler for large-scale customer engagements and is viewed as a powerful tool to attain high-energy savings at a low price (Oinas-Kukkonen & Harjumaa 2009; Watson et al. 2008). The energy efficiency website applies socio-psychological concepts such as social norms, social comparisons and goal setting to stimulate behavior change and further allows us conducting experiments in a real world-setting. Since April 1st 2010, 9,929 users have joined Velix and have entered more than 217,299 meter readings. The website has about 450 visitors per day, with an average time spent on Velix of about 5.15 minutes.

An intervention that appears to be especially promising for triggering changes in user behavior is the activation of social norms. People often orient themselves toward others to observe what behavior is commonly performed (descriptive norm) and thus learning the behavior appropriate to a given situation that will be appreciated by others (injunctive norm) (Cialdini et al. 1991). Social norms have been successfully applied to motivate residents to reduce their energy consumption. Schultz et al. (2007) gave participants either descriptive or descriptive and injunctive normative feedback on their energy consumption and found that the energy customers either reduced or maintained their levels of consumption when they were presented with both injunctive and descriptive normative feedback. Descriptive feedback proved to be counterproductive for individuals who were below average consumers because they increased their consumption as soon as they learned that they perform better than the average. However, this study did not use IS to give feedback; instead, feedback was provided on door hangers and distributed by scientific staff. Therefore, the normative social feedback included personal interaction. In this paper, we present a study that tested whether social normative feedback is applicable to scalable online campaigns that do not involve personal interaction.

Testing whether social normative feedback is effective if it is presented via a website is highly relevant, as it aids the design of future information systems that should maximize the effects from measuring consumption information in a scalable and cost-efficient way. The emerging Smart Metering infrastructure—based on utility meters that measure and make available consumption data electronically—renders possible IS that takes the current consumption of households as an input variable. This enables feedback systems that inform individuals about their energy usage, thus providing an instrument to adjust personal behavior towards more sustainable consumption. The fact that these systems should not only reflect but also alter consumer behavior of the users—very often even in a personal environment and sometimes competing with leisure time activity—highlights the challenges with respect to system design. The legislation in many countries (e.g., in the member states of the European Union) that make smart metering mandatory within the next decade highlights the relevance of research in this field. We further explore the influence of different types of feedback in terms of the frequency of system usage by individuals. This is especially interesting because a certain kind of feedback might be effective to trigger a desired change in behavior but might, at the same time, reduce the likelihood that a customer will voluntarily return to possibly receive similar feedback again.

The remainder of the paper is structured as follows: We first provide the reader with the theoretical background on Green IS, social norms, and their application in IS Research and formulate the hypotheses that are tested later in a field study. Thereafter, we describe the experimental design, outline the empirical analysis and present the results. We conclude with a discussion on the implications of the findings for practice and future research.

Theoretical Background

Green IS Design

Given the limited number of publications in leading IS journals and conferences, it seems that Green IS is still a relatively new topic. Many works are rather conceptual in nature and concentrate on the definition and discussion of essential terms (Molla 2009, Jenkin et al. 2011b), the practical value of Green IS research, gaps in previous research, and the resulting promising areas for research (Hasan & Dwyer 2010). Furthermore, most studies focus on the organizational level of analysis. However, very recently, some IS researchers have employed the idea that individuals play an important role in realizing environmental sustainability. For example, Melville (2010) proposes the *Belief-Action-Outcome Framework (BAO),* which emphasizes the mediating role of individuals in linking macro-level variables such as social structure and the behavior of the social system. Specifically, individual psychic states (e.g., beliefs about the environment) are shaped by social and organizational structures and influence sustainability actions on an individual, organizational, and social level. Among all mentioned frameworks, the model described by Melville (2010) most explicitly calls for research on IS design issues for action formation.

There are only a few examples of IT artifacts for influencing individual consumption behavior. One example is the iParrot (Mahmud et al. 2007), which is a paper mock-up of a parrot that is shown in a video and presented to a sample of 30 subjects either online or in the laboratory. The parrot worked as a social actor and was seen in different scenes (e.g., the parrot leaves the room and leaves the television on standby mode). The friendliness of the social actor varied. Results showed that individuals will conform to the advice of an IT-based social actor when it is friendly. Holmes (2007) presents a public art project that measures electricity usage for the purpose of education and the curtailment of power usage. Specifically, the authors presented a display in a university campus building that showed a group of trees, with the number of trees and details being dependent on the amount of energy consumed. The less energy individuals consume, the fewer the trees were in the display, but more details were displayed. The author discusses to what extent visualizations of real-time energy consumption patterns trigger more ecologically responsible behavior. Shiraishi et al. (2009) present a different eco-visualization approach. They designed an in-home display that shows EcoIsland, an artificial world where every family member is represented by an avatar. This artifact aims at motivating families to reduce their CO2 emissions. If the family members show many behaviors that are related to high emissions, the island will sink. EcoIsland was evaluated by means of a field study with six families over a period of six weeks. Froehlich (2009) developed a mobile phone application called UbiGreen, a tool for tracking and supporting green transportation habits. Users are provided with system feedback about sensed and self-reported transportation behaviors. UbiGreen was evaluated in a three-week field study with 14 participants. Grevet et al. (2010) created a website called stepgreen.org, which incorporates visualization of energy consumption data regarding whether individuals save more energy when they receive either individual feedback or social feedback. The study was conducted with 40 participants over a period of four weeks. Björkskog et al. (2010) combine wireless sensors, mobile, and ambient interfaces and discuss the design of a system called ‘Energy Life.’ Energy Life integrates elements of computer games, with participants playing through different levels, collecting scores through savings and advice/tip reading and quizzes. Thus far, the system has not been evaluated empirically.

Although the latter works refer to social psychology literature in the design of the respective artifacts, they do not formulate testable hypotheses and thus do not attempt to confirm any hypotheses using large data samples collected from real users. In contrast, a more theory-driven study was conducted by Graham et al. (2011). In their study, the authors investigate the impact of an online intervention on 128 college students’ use of their cars. One group of students was asked to visit a web page every two days and to report the number of times they had decided not to use their car as well as how many miles they avoided driving on each trip not taken. In a 2 × 2 design, participants received feedback on pollution avoided and/or gas money saved. The results show that students who visited the website reported driving less than the no-Web control group. Furthermore, the subgroup of students who received both types of feedback reported driving less than all others. The latter study hints to the opportunity for IS research that traditionally combines technological expertise with psychological theories (Lim et al. 2009) which is consistent with the increasing emphasis on the social context of IS (Sidorova et al. 2008).

Social Normative Influence

It is widely recognized that there are different forms of social influence. Whereas normative social influence describes the influence of other individuals that leads us to conform in order to be liked and accepted by them, informational normative influence occurs when we conform because we believe that another's interpretation of an ambiguous situation is more accurate than ours and will help us choose an appropriate course of action (Deutsch & Gerard 1955). Similarly, the *‘Focus Theory of Normative*

Conduct', a prominent theory of social psychology by Cialdini and colleagues (1991), refines the concept of social norms by differentiating between descriptive and injunctive norms. Descriptive norms inform individuals about what most people do (the norm of 'is'), whereas injunctive norms inform individuals about what most people approve or disapprove of (the norm of 'ought') (Cialdini et al. 1991). Social norms have a powerful influence on human behavior and have been applied during the last two decades to change a wide range of behaviors, including littering (Cialdini 2003), eating (McFerran et al. 2010), drinking (Lewis and Neighbours 2006), towel reuse (Goldstein et al. 2008), and energy consumption (Siero et al. 1996, Schultz et al. 2007). It is known to be one of the most powerful determinants of behavioral change, as individuals often look to social norms to gain an accurate understanding of and effectively respond to social situations, especially during times of uncertainty (Cialdini 2001). Furthermore, individuals adapt their own behavior to social norms in order to be liked and accepted by other individuals (Aronson et al. 2009). Consumers may follow such norms without giving it much thought (Melnyk et al. 2010). A meta-analysis revealed that social norms have a strong effect on both attitudes and behavior; they are especially effective in the context of socially responsible behavior (Melnyk et al. 2010). Apart from refining the concept of social norms, the focus theory of normative conduct further specifies the circumstances under which social norms actually affect behavior. To influence an individual's behavior, a norm must be focal for an individual at the time of behavior (Cialdini et al. 1991; Kallgren et al. 2000). The heuristic model of environmentally relevant behavior also stresses the relevance of norm activation to help norms enter the decision process to change potentially detrimental routines that are affecting energy conservation (Fischer 2008). In the context of pro-environmental behavior, a common means to activate social norms is the use of feedback. Social normative feedback does not only activate social norms but also provide orientation in telling people what others do and what behavior is socially desired and therefore is capable in influencing the whole decision process (Fischer 2008).

Studies examining the effect of normative feedback on energy consumption (Abrahamse et al. 2005, Siero et al. 1996) have, however, reported mixed results. Fischer (2008) assumes that while normative feedback stimulates high users to conserve energy, it suggests low users that things are going not so bad and they may upgrade a little as a consequence. According to Schultz and colleagues (2007), this problem originates from the application of the wrong type of norm. Many studies provided information about the amount of energy that consumers use as a descriptive norm that may "act[s] as a magnet for behavior for individuals both above and below the average" (Schultz et al. 2007, 430). As a consequence, boomerang effects can occur when individuals who already demonstrate a desirable behavior adjust to the descriptive norm. To examine how normative messages can have differential effects depending on whether the message recipient's behavior is above or below the norm, Schultz et al. (2007) conducted a study of 290 households in California over a period of eight weeks. According to the baseline consumption of these households, the authors assigned the participants to either a high or low energy-consuming group. Within each group, one half of the households received feedback on their energy consumption (in kilowatt hours) for the previous week and on the consumption of an average household in their neighborhood. The second half of the households received the same information and additional injunctive feedback, which was represented by a handwritten smiley face to indicate the approval of their energy consumption. The feedback was provided on door hangers. For the above-average energy consumers, any type of feedback led to a decrease in consumption. In contrast, individuals who consumed less energy compared to their neighbors increased their consumption in response to the descriptive normative feedback on their performance. However, with the addition of the injunctive feedback, the energy consumption of below-average energy consumers remained at a desirably low level. Injunctive norms are thus able to offset the boomerang effect that descriptive normative feedback causes. These findings ended a long-standing controversy with regard to the general effectiveness of social norm interventions.

Social influence in the realm of IS Research has been found to be an important factor for technology adoption and use (Brown & Venkatesh 2005, Eckhardt et al. 2008, Eckhardt 2009, Karahanna et al. 1999, Liang et al. 2010, Sykes et al. 2009, Venkatesh et al. 2003), recommendation systems (Kumar & Benbasat 2006, Zheng et al. 2010), social networks (Lichtenstein et al. 2010, Oinas-Kukkonen et al. 2010, Yu et al. 2010), website design (Cyr et al. 2009, Hess et al. 2009, Wakefield et al. 2011) and viral marketing (Bampo et al. 2008). However, social influence in IS research is still the "unloved child" of technology adoption research (Davis et al. 1989; Lu et al. 2005) and thus is an issue that needs to be much more clearly examined. There are a few theories in the area of IS research that account for the importance of social influence such as the '*Theory of Planned Behavior*' (Ajzen 1991), the '*Social Influence Model of Technology Use*' *(*Fulk et al. 1990), the '*Diffusion of Innovations Theory*' (Rogers 2003) and the '*Social learning theory*' (Bandura 1977). However, all of these theories are concerned with explaining the influence of other individuals on technology use. This study, in contrast, addresses the normative social influence technology or information systems such as websites may convey on individual behavior.

Research in the field of persuasive technology raises hope that information systems are capable in excerpting social influence on individual behavior. Researchers have shown that individuals respond socially to computers and that individuals' interactions with computers are fundamentally social (Reeves & Nass, 2003; Fogg 2002). For example, in a study by Fogg (2002), subjects had to perform certain tasks together with the computer and were afterwards either asked by the computer or by the experimenter to rate the performance of the computer. Results showed that individuals gave friendlier ratings when asked by the computer, which indicates that individuals apply the norm of courtesy even to computers. In another study, Fogg (2002) investigated whether praise from a computer would generate positive effects similar to praise from individuals. He found that whether praise is false or not, individuals felt better about it, were in a better mood, felt more powerful, felt they had performed well, found the interaction engaging and were willing to work with the computer again. However, social responses to computers are not the result of conscious beliefs that computers are human or human-like (Reeves & Nass 2003). Social responses to computers are commonplace and easy to generate. In addition, a limited set of characteristics associated with humans provides sufficient cues to influence behavior (Reeves & Nass 2003). Computers are therefore capable of persuasion. Furthermore, they can leverage the principles of social influence because face-to-face interactions do not seem to be a prerequisite for social normative influence. A study by Midden and Ham (2009) has assessed the effect of social feedback given by robotic agents to motivate individuals to use less energy. Participants were asked to do washing tasks with a simulated washing machine. They set the conditions via a virtual display. Participants were either given factual feedback (kWh used) or social feedback by iCat, a robotic agent that praised the participants and smiled at them. Results of both studies indicate that social feedback has stronger persuasive effects than factual feedback. In addition, the participants saved more energy when they received negative feedback than participants who received positive feedback. Negative social feedback had the strongest persuasive effects.

However, studies such as the latter occur in a laboratory setting with small sample sizes and do not test the effect of social feedback on actual conservation behavior. Furthermore, robotic agents are still very vivid and include a variety of human characteristics, such as speech, voice, and facial expressions. Another problem with robotic agents is that individuals need to be provided with such a device, which imposes another usage barrier and is neither scalable nor cost-effective. We therefore want to test whether a website can convey social feedback and thus motivate energy savings as well as frequent website usage.

Hypothesis Development

According to the '*Social Presence Theory*' (Short et al. 1976), certain website features may establish a feeling of social presence. Social presence implies a psychological connection with the user, who perceives the website as warm, personal, and sociable, thus creating a feeling of human contact (Yoo & Alavi 2001). Websites typically lack social presence compared to face-to-face interactions due to the lack of social cues such as facial expressions, gestures, and sounds (e.g., Straub & Karahanna 1998). However, there are certain website features that are capable of creating a social presence. Among these features are socially rich text content, personalized greetings (Gefen et al. 2003), pictures of other individuals (Hassanein & Head 2007), human audio (Lombard & Ditton 1997), and human video (Kumar & Benbasat 2006). We assume that descriptive normative feedback (comparison to the average) as well as injunctive normative feedback (approval/disapproval of a person's energy consumption) may create social presence and therefore excerpt social normative influence, motivating individuals to save energy. We expect that descriptive normative feedback as well as injunctive normative feedback delivered by a website will cause the same effects as in the study of Schultz et al. (2007), in which social normative feedback is connected to personal interaction.

H1a: *Descriptive normative feedback delivered via a website will result in decreased energy consumption for above average consumer and increased consumption for below average consumer.*

H1b: *Injunctive normative feedback delivered via a website will motivate energy savings for both above and below average consumers.*

However, it is not sufficient to only test the effects of descriptive and injunctive normative feedback on energy consumption. It is possible that a certain kind of feedback might effectively trigger a desired change in behavior but might, at the same time, reduce the likelihood that a customer will voluntarily return to possibly receive similar feedback again. The second hypothesis thus aims at exploring the influence of different types of feedback in terms of the frequency of system usage. Research has shown that the two types of social norms are associated with different goals. Whereas descriptive norms are associated with the goal of making accurate and efficient decisions, injunctive norms are associated with gaining or maintaining social approval (Jacobson et al. 2011). We therefore assume that participants who receive injunctive feedback in addition to descriptive feedback will use the website longer than participants who receive descriptive normative feedback only because the first group of participants will try to gain social approval the next time. Social approval is strongly related to self-esteem, and individuals seek to increase social acceptance from others (Leary et al. 2001).

H2: *Injunctive normative feedback is superior to descriptive normative feedback in terms of repeated system usage.*

Empirical Study

Subjects and Design

We conducted a field study with 220 customers of a utility company in Austria where we tracked energy consumption over a period of six weeks. The study comprised two experimental groups that compared the effects of descriptive normative feedback with descriptive plus injunctive normative feedback on energy savings. The feedback types were randomly assigned in a between-subjects design at the time of registration so that participants have not been interacting with the system before. All subjects were provided with suggestions on ways to conserve energy by the utility company. In accordance with the procedure by Schultz and colleagues (2007), we quasi-experimentally divided our sample into two subgroups, based on their baseline energy consumption level (below vs. above the median) and analyzed the data separately for both groups. We excluded the 5% of the participants who had the most extreme levels of energy consumption from further analyses.

Procedure

To test our hypotheses, we developed an energy efficiency website called "Velix" in cooperation with an Austrian utility company to provide their energy customers with feedback on electricity consumption and to support them by providing energy-saving tips. Velix is based on the assumption that the combination of novel information technologies with psychological concepts can be a powerful tool to exert a positive influence on individuals' energy consumption behavior, while, at the same time, addressing a large target group at a low cost. The website serves as a basis for the company's energy-saving campaign and is available to all private customers since April 1st 2010, who can easily register online. Every new user is automatically assigned to an experiment after registration. Based on the assignment, Velix then provides the participant with a different type of feedback (cf. figure 1), based on a specific socio-psychological concept. Since April 1st 2010, 9,929 users have joined Velix. The website has about 450 visitors per day, with an average time spent on Velix of about 5.15 minutes. To promote the website, the utility company informed their customers via their customer magazine and teamed up with a local media corporation that placed ads in newspapers and the news website. Velix combines energy record-keeping with game-like tasks. Customers are incentivized with bonus points to read their electricity meter on a weekly basis and enter the readings online. To ensure the collection of reliable self-reported data, we applied multiple strategies. First, we incorporated detailed graphical and textual instructions on the location of the electricity meter and how to read it. The utility company has been using this information for many years to support customers who read the electricity meter for billing purposes. Second, we implemented algorithms that assess the validity of the manually entered electricity meter readings. For example, if a customer enters a negative value or a reading that is lower than the previous reading, he or she will get an error notification. In addition, we are confident that the collected data were reliable because it is complex and profitless to fake meaningful counter readings over a period of six weeks to receive unhelpful feedback. Additionally, we checked the validity of the self-reported data for a subset of 115 customers. The correlation between the level of the yearly energy consumption for 2009 (read by the utility company) and the level of the yearly energy consumption for 2010 (a projection based on the self-reported baseline consumption) was substantial (r = .80, p < .01). This correlation indicates that the self-reported data can be assumed to be valid.

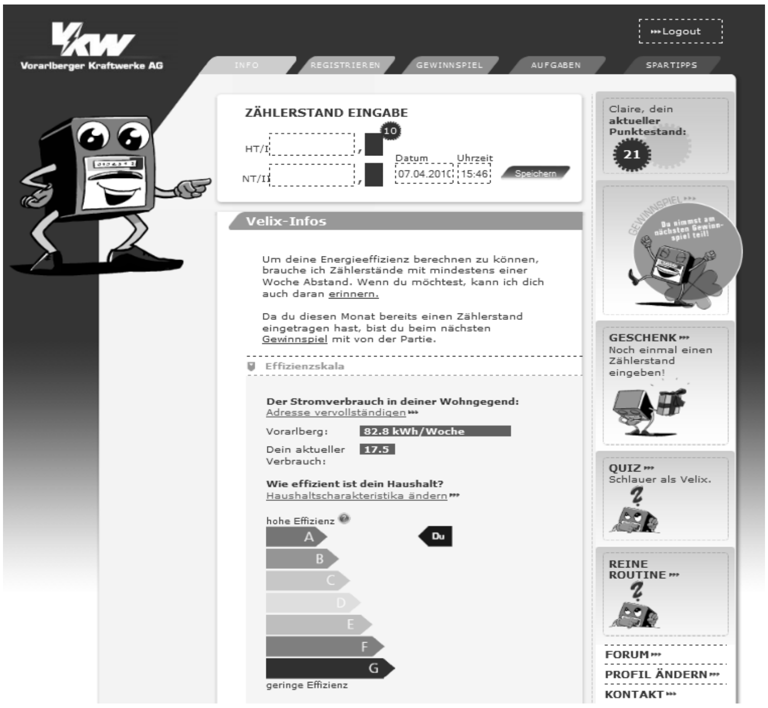

Figure 1. Data entry and descriptive and injunctive normative feedback on energy provided by Velix

Intervention

After entering the second meter reading (one or two weeks after entering the first one), Velix calculates the energy consumption and provides the user with feedback to stimulate energy conservation. We used historical data from all of the customers at the utility company to provide the participants with descriptive normative feedback on their consumption of electricity (cf. figure 1: bar chart). In the descriptive feedback condition, we presented a bar chart that compared their weekly energy consumption (in kilowatt hours, lower bar) to the average energy consumption of similar households (regarding size and heating system) in the considered region of Austria (upper bar). Descriptive normative feedback therefore told consumers how much electricity they use per week in absolute numbers (here: 17.5 kWh) and whether they were better (as in figure 1) or worse than the average household in their region. In the descriptive plus injunctive feedback condition, we added injunctive normative feedback to the bar chart (cf. figure 1: efficiency level). The injunctive feedback used grades from A to G, with A representing a high level of approval of the customer's energy consumption and G representing a high level of disapproval. The approval or disapproval is further indicated by the colors that range from green (A) to red (G). The energy efficiency scale is widely used in Europe within the context of energy certificates for buildings. They are also used to label the efficiency of white goods. The injunctive feedback on the household's energy efficiency took into account some basic household characteristics (e.g., main heating system and household size). In addition to feedback, the participants were provided suggestions on ways to conserve energy by the utility company. Customers could use a customer-care hotline, a contact form, and a forum to contact the utility company with questions regarding the feedback on energy consumption.

Results

Hypothesis 1a and 1b aimed at testing whether descriptive normative feedback when delivered via a website reduces consumption for above average users and increases consumption for below average users and whether descriptive plus injunctive feedback leads to low consumption levels for both above and below average consumers. These results were found when the two types of feedback were given personally and were hypothesized to occur, too, when feedback is given via a website due to the capability of social normative feedback to cause social presence and thus excerpt social influence. To test the effects of both feedback types for above and below average consumers we conducted an independent t-test for each group (above median vs. below median) separately. The results show that descriptive feedback does have a negative effect if given to consumers whose energy consumption is low (baseline: 58.85 kWh/week): they consume 4.85 kWh more per week. This means that for below-average energy consumers, descriptive feedback increases consumption. However, above-average energy consumers (baseline: 106.11 kWh/week) reduce their consumption, on average, by 7.13 kWh ($SD = 31.89$, $t(112) = 3.53$, $p < .05$). The combination of injunctive and descriptive feedback, in contrast, maintains energy consumption at a desirable, low level for below-average energy consumers ($M = 0.52$, $SD = 12.54$) and also decreases energy consumption for above-average energy consumers ($M = -7.13$, $SD = 31.89$). This means that the combination of descriptive and injunctive normative feedback is effective for both above-and below-average energy consumers ($t(95) = 1.57$, $p > 0.5$, cf. Figure 2). These findings confirm our hypotheses.

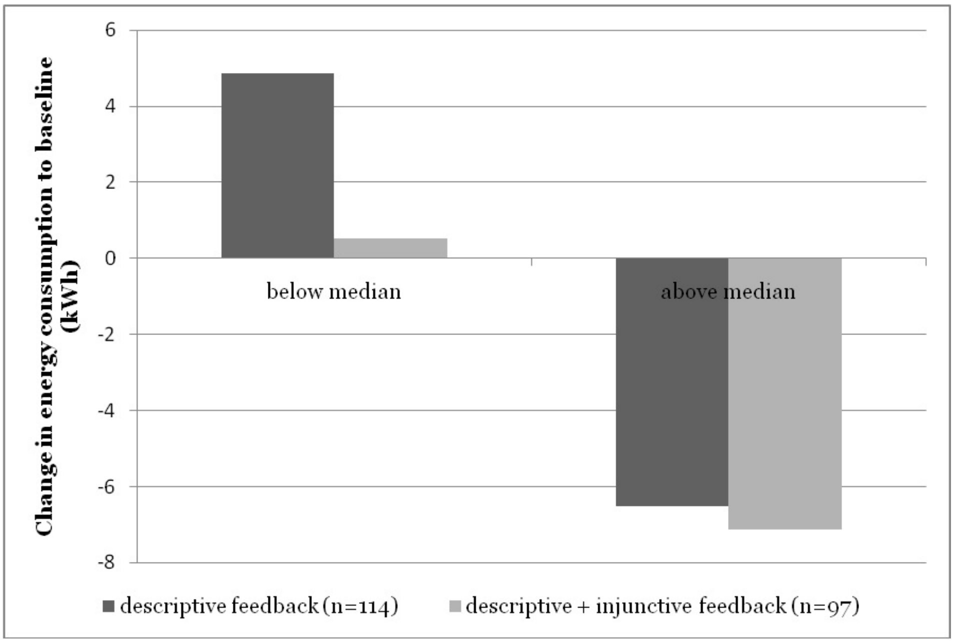

Figure 2. The influence of the type of feedback on changes in energy consumption from baseline (kWh).

Hypothesis 2 aimed at testing whether the combination of injunctive and descriptive normative feedback is superior to descriptive normative feedback only in terms of repeated system usage. We assumed that participants who receive injunctive feedback in addition to descriptive feedback will use the website more frequently than participants who receive descriptive normative feedback only because injunctive norms are associated with gaining or maintaining social approval (Jacobson et al. 2011) and is therefore strongly related to self-esteem. An independent-sample t-test was conducted to compare the frequency of website usage under conditions of descriptive normative feedback and descriptive plus injunctive normative feedback. Our results show that both participants who receive descriptive normative feedback only and participants who receive injunctive normative feedback in addition to descriptive normative feedback enter their meter readings, on average, 1.98 times a week (SD = 1.19 vs. SD = 1.03). There is therefore no significant difference between the two groups ($t(209) = .02$; $p > .10$; cf. Figure 3). This implies that the type of social normative feedback has no differential effect on the frequency of website usage.

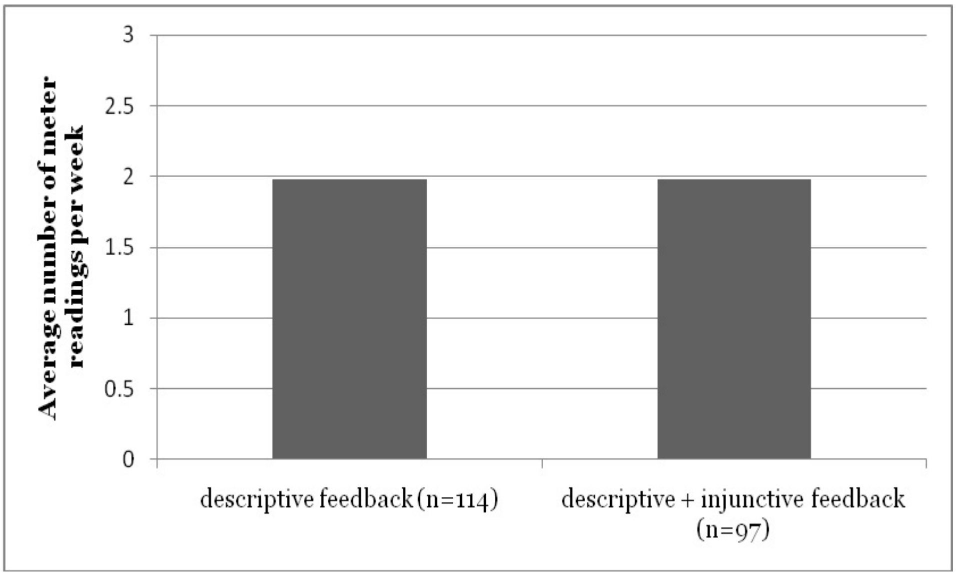

Figure 3. The influence of the type of feedback on the frequency of website usage (entered electricity meter readings per week).

Discussion

Summary of Main Findings

In this paper, by means of a field study with real customers of a utility company, we tested how innovative IS for energy monitoring (in this case, a website) should be designed. We thereby respond to the call made by Melville (2010) for research on the effectiveness of IS design choices in influencing environmentally sustainable human behavior. Specifically, we investigated the influence of two types of social normative feedback on both energy consumption and website usage. Against the background of the focus theory of normative conduct (Cialdini et al. 1990), the computer as social actors approach (Reeves & Nass, 2003; Fogg 2002). as well as the social presence theory (Short et al. 1976) we assumed that social normative feedback will exercise social influence if delivered via a website and not personally and will therefore be suitable for applying it in the context of scalable interventions that use information systems to provide energy consumers with feedback on their consumption. We find that descriptive normative feedback and injunctive normative feedback differ with regard to their effectiveness on energy consumption. For below-average energy consumers, descriptive feedback increases consumption, whereas the combination of injunctive and descriptive feedback maintains energy consumption at a desirable, low level. For above-average energy consumers, any feedback leads to a decrease in consumption. The findings show that the combination of the two types of feedback motivates both above- and below-average energy consumers to reduce or maintain their levels of energy consumption. We further examined whether injunctive and descriptive normative feedback differs with regard to the frequency of website usage. We assumed that participants who receive injunctive feedback in addition to descriptive feedback will use the website more frequently than participants who receive descriptive normative feedback only because injunctive norms are associated with gaining or maintaining social approval (Jacobson et al. 2011) and is therefore more relevant for maintaining or improving self-esteem. We found that there was no significant difference; we can conclude that neither injunctive nor descriptive normative feedback motivates individuals more to use the website on a regular basis.

Implications for Theory and Practice

Our findings allow for drawing a number of implications for theory and practice. We showed that the two types of feedback have the same effects as social normative feedback with personal interaction when they are delivered by a website, and we were thus able to replicate the findings of Schultz et al. (2007). The two feedback types involved a social comparison displayed by a bar graph and social approval represented by a mark and therefore made sparse use of social elements. Nevertheless, the feedback seems to have created a feeling of social presence. So far, it has been known that website features such as pictures of other individuals, human audio or human video (Hassanein & Head 2007, Kumar & Benbasat 2006, Lombard & Ditton 1997) are capable of creating a social presence. Based on our results we assume that it is sufficient to exert social normative influence by simply arousing associations with a reference group. We thus add to the knowledge on *Social Presence Theory* (Short et al. 1976). Luckily, the two types of social normative feedback did not prove to have differential effects on website usage so that we do not expect social normative feedback to backfire on the long run. Customers seem to use the website for primary reasons other than social comparisons. A survey among the website users revealed that the majority (49%) use "Velix" to know how much energy they use, whereas only 14% primarily use the website to compare themselves to others. We further add to the research on Green IS by developing an IT artifact that works as an enabler for a large-scale customer's energy efficiency campaign and therefore provide an added value for both the utility company and its customers while positively influencing consumption behavior (Oinas-Kukkonen & Harjumaa 2009). Unlike previous research, we tested the IT artifact in a real-world setting with a large sample over a period of several weeks, thereby providing evidence that IT can improve sustainability not only at the organizational but also at the individual level.

With regard to practice, our results have powerful implications for managers of energy efficiency campaigns that provide feedback on energy consumption as well as for IT specialists who design user interfaces for smart metering infrastructures. Injunctive feedback can be recommended as an efficient means of providing consumption feedback, as it decreases or keeps low the consumption of high and low consumers of energy. If descriptive normative feedback is used, below average consumers perceive that things are going not so bad and they may therefore upgrade a little (Fischer 2008). IS-based behavioral interventions – if designed carefully - contribute to accountable savings and therefore help utility companies to fulfill future regulatory requirements at low cost. The lack of the effect of the two types of feedback on website usage seems to make feedback that dynamically adapts over time to prevent user reactance unnecessary; at least, if the information system provides additional value such as saving tips, historical consumption feedback and various reward systems. In sum, the results evidently indicate that the type of feedback determines whether the goal of the system ("reduce energy consumption") is achieved. This clearly underlines how important it is to consider user behavior in the design of IT-based efficiency campaigns.

Limitations and Further Research

Even though every effort has been made to ensure the validity of our findings, the present study comes with limitations that point to opportunities for future research. Because we used real-life data, limitations include the limited control of the experimental factors and the lack of processing data. Future research should aim to understand the cognitive and emotional mechanisms behind the differential effects of descriptive and injunctive normative feedback on energy conservation. A second limitation concerns the collected data sample. Although the sample of households is quite large, a bias in results cannot completely be ruled out, as customers participated in the study voluntarily, and thus intervention effects might be overestimated. On the other hand, the field study conducted under real-world conditions offers insights into the effects of real campaigns. A last aspect refers to the persistence of the effects that social normative feedback produces. Although we were not able to find effects on website usage it can be assumed that the effect diminishes over time. Schultz et al. (2007) tested the effects for 8 weeks and in our study we monitored energy consumption for six weeks. Future studies should extend the follow up phase. However, we conclude that IS has the potential to contribute to solving environmental problems (Watson et al. 2008) if it considers user behavior in the design.

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