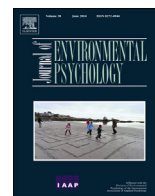




Contents lists available at ScienceDirect

Journal of Environmental Psychology

journal homepage: www.elsevier.com/locate/jep

Antecedents and consequences of monitoring domestic electricity consumption



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ARTICLE INFO

Article history:

Available online 15 July 2014

Keywords:

Theory of planned behavior
Self-monitoring
Smart meter
Home energy monitor
Real time display
The ostrich problem

ABSTRACT

Despite evidence that monitoring domestic electricity usage can reduce consumption, there is currently little information on what factors motivate people to monitor their consumption. The present research used an augmented version of the theory of planned behavior as a framework for understanding householders' intentions. Participants ($N = 346$) completed a questionnaire measuring their beliefs about electricity use and monitoring consumption, their environmental behavior, and concern about climate change. Regression revealed that the primary predictors of intentions to monitor consumption were perceived behavioral control, attitudes toward monitoring, past behavior, descriptive, and subjective norms. In addition, we developed a modified home electricity monitor that legged when participants looked at their consumption. A subset of participants ($n = 38$) were given a monitor for three months. Participants looked at the monitor relatively frequently during the first week but usage rapidly declined. There was, however, some evidence that participants found the monitor beneficial.

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The UK Government has committed to installing smart meters in all UK homes by 2019 (DECC, 2012) and similar plans exist across the EU and US. It is proposed that one of the key advantages for consumers of having a smart meter will be the accompanying free-standing display that will provide information on electricity use in real time (DECC, 2009); although the UK is relatively unique in mandating the offer of a home energy monitor to every householder who has a smart meter installed. The hope is that providing immediate feedback on electricity use will increase energy literacy and foster changes in behavior that can reduce electricity consumption. Research to date supports this assertion, with a number of large-scale studies suggesting that the provision of electricity monitors can lead to reductions in electricity usage (e.g., AECOM, 2011; Commission for Energy Regulation, 2011), although this effect is dependent on the quality and type of feedback provided (for reviews, see Abrahamse, Steg, Vlek, & Rothengatter, 2005; Burgess & Nye, 2008; Darby, 2006; Faruqui, Sergici, & Sharif, 2010) and may

not be sustained over long time periods (e.g., van Dam, Bakker, & van Hal, 2010).¹

Research has also begun to consider how people use the information obtained from home electricity monitors. For example, Hargreaves, Nye, and Burgess (2010) interviewed 15 householders who had purchased one of three types of electricity monitor. They found that householders preferred to view information on electricity usage in terms of cost, rather than absolute measures of consumption, and that householders used the monitors to identify the costs associated with the use of different electrical appliances. For example, when the monitor indicated that current usage was high, householders reported that they would switch off unused appliances. In addition to studies on domestic electricity monitoring, there is also an extensive literature on how people respond to feedback (e.g., on their performance at work, on lab-based tasks and so on); research that could be used to understand the impact of information about home electricity consumption on householders' thoughts and behaviors. For example, Kluger and DeNisi (1996) reviewed 131 studies and found substantial, but variable, effects of feedback interventions on behavior. The resulting Feedback Intervention Theory (FIT) proposes that feedback serves to change the locus of attention (e.g., from the self as an 'environmentally conscious' person, to actual electricity usage) which, in turn, influences behavior.

There are, however, important questions that need to be addressed before examining how people use the information

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¹ The focus of the present research is on electricity, rather than gas, consumption both for practical reasons (there are currently few commercially available displays for gas usage) and because real-time feedback is more relevant to electricity consumption than to gas (Raw & Ross, 2011).

obtained from monitoring domestic energy use or respond to feedback – for example, to what extent are people actually motivated to look at the information provided by home electricity monitors? It is currently difficult to find an answer to this question, but Wallenborn, Orsini, and Vanhaverbeke (2011) provide indicative evidence. They report the findings of a survey, which suggests that 69% of Belgians would pay more attention to their electricity consumption if their appliances displayed this information (Wallenborn, Rousseau, & Thollier, 2006). It is also currently unclear how often people actually look at home electricity monitors and what factors influence how motivated people are to monitor their domestic electricity consumption.

These questions are important from both a theoretical and an applied perspective. From a theoretical perspective, frameworks highlight the value of self-monitoring for promoting effective self-regulation and behavior change (e.g., Carver & Scheier, 1982; Ford, 1987; Louro, Pieters, & Zeelenberg, 2007; Miller, Galanter, & Pribram, 1960; Powers, 1973; Powers, Clark, & McFarland, 1960a, 1960b) and empirical studies and reviews support these ideas (see Bravata et al., 2007; de Bruin et al., 2012; Dombrowski, Sniehotka, Avenell, MacLennan, & Araujo-Soares, 2012; Greaves et al., 2011; Harkin et al., 2014; Michie, Abraham, Whittington, McAteer, & Gupta, 2009; Michie et al., 2012). However, we currently understand little about the factors that influence when people are likely (vs. unlikely) to monitor their current standing with respect to their goals. Recent reviews suggest that people may experience difficulties in monitoring, such that, in some circumstances, they are unable or unwilling to do so (Lieberman & Dar, 2009; Webb, Chang, & Benn, 2013). From an applied perspective, understanding the factors that influence peoples' motivation to monitor their domestic electricity consumption may help to identify targets for interventions designed to encourage the uptake of domestic electricity monitors and to motivate their use. For example, if motivation is determined primarily by peoples' attitudes toward monitoring electricity consumption, then persuasive communications could be developed that engender positive attitudes toward monitoring.

1. The theory of planned behavior

In the present research, we propose that the decision to monitor domestic electricity consumption is a planned behavior much like the decision to take exercise or to cook dinner. Therefore, monitoring electricity consumption can be understood in terms of frameworks for understanding planned action, such as the theory of planned behavior (TPB; Ajzen, 1991). The TPB suggests that the proximal determinant of a person's behavior is his or her decision about how to behave (or behavioral intention). Intentions are usually measured by endorsement of items such as "I intend to do X!" and indicate the direction and strength of a person's motivation (Ajzen, 1991; Gollwitzer, 1990; Webb & Sheeran, 2005; 2006). According to the TPB, there are three predictors of intention: attitude, subjective norm, and perceived behavioral control. Attitudes reflect the individual's evaluation – positive or negative – of engaging in a particular behavior (Eagly & Chaiken, 1993). For example, Hargreaves et al. (2010) reported that, while some participants believed that monitoring their domestic electricity consumption would be worthwhile and interesting, others were less interested in feedback. Subjective norms refer to beliefs about whether others would approve or disapprove of the person engaging in the focal behavior. Qualitative research by Hargreaves et al. reported that some participants felt that others did not necessarily approve of their monitoring electricity consumption (e.g., "my wife's not that interested in it", p. 6115). Finally, perceived behavioral control is similar to Bandura's (1977) concept of self-efficacy and reflects

beliefs about whether one has the necessary resources, abilities, or opportunities to perform the behavior successfully. Thus, although people may have positive attitudes toward monitoring their domestic electricity consumption, and believe that those important to them would approve of their so doing, they may still not intend to monitor their electricity consumption because they believe that this behavior is out of their control. For example, those in shared accommodation (such as student halls of residence) may hold this opinion because they find it difficult to isolate the electricity supply to their accommodation (Kyriakidou, Tucker, Jones, & Webb, 2011).

The TPB has received widespread support as a model of behavior. For example, Armitage and Conner (2001) found that variables specified by the TPB accounted for 27% and 39% of the variance in behavior and intention, respectively. Consistent with predictions, moderate- to large-sized correlations (Cohen, 1992) were found between attitude and intention ($r_+ = 0.49$), subjective norm and intention ($r_+ = 0.34$), and perceived behavioral control and intention ($r_+ = 0.43$). Behavior was significantly predicted by both intention ($r_+ = 0.47$) and perceived behavioral control ($r_+ = 0.37$). The TPB has also been used to understand behaviors relating to the environment, such as the use of public transport (Heath & Gifford, 2002), the consumption of meat (Harland, Staats, & Wilke, 1999), the use of energy saving light bulbs (Harland et al., 1999), switching off lights in the workplace (Greaves, Zibarras, & Stride, 2013), recycling (Cheung, Chan, & Wong, 1999; Nigbur, Lyons, & Uzzell, 2010), intentions to visit an environmentally-friendly hotel (Han, Hsu, & Sheu, 2010), efforts to reduce the environmental impact of organisations (Cordano & Frieze, 2000a, 2000b), and environmental behavior generally (Kaiser, Wolfing, & Fuhrer, 1999). However, to our knowledge, no study to date has investigated whether the TPB can be used to understand the extent to which people monitor their domestic electricity consumption.

2. Augmenting the TPB: anticipated affect, descriptive norms, past behavior, environmental beliefs, and self-identity

Despite the success of the TPB, a number of authors have suggested that the model may usefully be supplemented by additional constructs. First, people may believe that the implications of the information they glean from monitoring may be unpleasant (e.g., higher than expected electricity usage may suggest that one is less environmentally friendly than thought) and so anticipate that monitoring electricity consumption will lead to negative affect (e.g., feelings of worry and guilt, Webb et al., 2013). Anticipated emotions have been shown to be important in determining the choices that people make (Mellers & McGraw, 2001) and measures of, for example, anticipated regret have been shown to predict intentions to exercise (Abraham & Sheeran, 2004) or play the lottery (Sheeran & Orbell, 1999) over and above the cognitions specified by the TPB (for a review, see Sandberg & Conner, 2008). We therefore measured whether participants anticipated that they would feel bad as a result of monitoring their domestic electricity usage.

Research has also pointed to the importance of supplementing subjective norms with descriptive norms that refer, not to perceptions of what others *think* one should do, but to perceptions of what others *actually* do (Cialdini, Kallgren, & Reno, 1991). For example, in a study of intentions to purchase lottery tickets, Sheeran and Orbell (1999) found that descriptive norms influenced intentions over and above attitude, subjective norm, and perceived behavioral control. Furthermore, a meta-analysis of 21 studies measuring descriptive norms revealed a medium-to-large-sized sample-weighted average correlation between descriptive norms and intentions ($r_+ = 0.44$, Rivas & Sheeran, 2003). It therefore seemed important to measure descriptive norms as well as

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