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Electricity saving in households—A social cognitive approach ☆

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ABSTRACT

We propose a conceptual framework for understanding the (lack of) energy saving efforts of private households based on Bandura's (1986) social cognitive theory. Results from applying this framework on a sample of Danish private electricity consumers are presented and it is concluded (a) that households' electricity consumption depends on both structural and motivational factors, (b) that their electricity saving effort depends on the strength of their internalized norms or self-expectations and on self-efficacy related factors, and (c) that there are predictable patterns of interaction among household members that influence their electricity consumption. The results suggest two approaches to promote electricity saving in households: (1) to change the socio-structural environment to be more facilitating for energy saving and empower householders to be more effective in their striving towards this goal through improved feedback about their household's electricity consumption and (2) social norms marketing, communicating social expectations and others' successful electricity saving achievements.

1. Introduction

In the quest for lowering greenhouse gas emissions and our reliance on fossil fuels, increasing attention is paid to the waste of energy in buildings, including private homes (Dietz et al., 2009; Ekins and Skea, 2009). It is well documented that the electricity consumption in private households could be lowered substantially if they paid more attention to unnecessary use of electricity and if this attention was followed by a change in everyday behaviors (e.g., Gram-Hanssen et al., 2004). Households can reduce their electricity consumption immediately, for example, by being more careful to switch off unnecessary light and electrical devices, by not keeping unused devices on standby, or by following some of the many other pieces of advice that can be found on dedicated websites as well as in many printed publications (e.g., Amann et al., 2007; Clift and Cuthbert, 2007). Private households that pay attention to their everyday electricity consumption might also attend more carefully and in a more timely fashion to the maintenance of their electrical appliances (e.g., defrosting the freezer) and replace devices that use too much energy earlier and more consistently (e.g., switch to energy saving light bulbs and replace fridges, freezers, etc., in a more timely manner).

As input to the development of effective policy to reduce the squandering of electricity in private households, it is the objective of this study to identify the most prominent drivers and impediments for saving electricity in this setting. Identifying the important drivers and impediments is the first step in designing effective intervention programs for reducing home energy consumption (Uitdenbogerd et al., 2007). As we will explain in the following, this implies identifying psychological, social, and structural antecedents of taking action to save electricity. We also address the effectiveness of private consumers' efforts to save electricity in terms of its impact on the household's electricity consumption.

Based on a review of previous research, a coherent theoretical framework is developed that specifies how psychological, social and socio-structural factors are linked to individual electricity saving behavior and to electricity consumption, directly or indirectly, as drivers or impediments. In the empirical part of the paper, the fit of the proposed model to a combination of individual level survey data and meter reading data is investigated. Finally, implications for the promotion of electricity saving in households are discussed.

2. Previous research

Behavioral research points at a number of reasons why consumers might not adhere carefully to the many useful pieces of electricity saving advice. These include the convenience of doing what one is used to do, lack of motivation, and a whole range of impediments which make behavior change difficult

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(e.g., Ritchie and McDougall, 1985). By way of organizing the large, diverse, and heterogeneous set of antecedents, a basic distinction is often made between psychological and contextual variables (Wilson and Dowlatabadi, 2007).

A wide range of psychological antecedents of home energy use and conservation behavior has been identified, including value priorities, outcome expectations, attitudes, personal norms, and self-efficacy (Ketola, 2000). According to recent research, home energy consumption is unrelated to general value priorities, but related (in the expected way) to more specific attitudes towards saving energy (Vringer et al., 2007). Attitudes towards saving energy depend on individuals' expectations about positive and negative outcomes of doing so (e.g., Black et al., 1985; Olsen, 1981). Some consumers may feel that the effort that is needed in order to save electricity is out of proportion to the potential private benefits. A large share of the population is also concerned about the environmental impacts of the high and increasing energy consumption (e.g., Bang et al., 2000; Poortinga et al., 2004, 2003), but this concern alone often seems insufficient to motivate action (e.g., Jensen, 2005; Pedersen and Broegaard, 1997).

Intentions to save energy also depend on the individual's social expectations (or subjective social norms) and self-expectations (or personal norms) (e.g., Black et al., 1985; Midden and Ritsema, 1983) as well as self-efficacy or perceived behavioral control (e.g., Harland et al., 1999). Self-efficacy is an issue because it is often difficult for an individual to perceive any effects of his or her effort to save electricity (Grimmig, 1992) or any relationship between their behavior and the household's electricity consumption (Gram-Hanssen et al., 2004). Further, in the bigger picture an individual's contribution may seem like a drop in the sea (cf. Berger and Corbin, 1992; Ellen et al., 1991).

The contextual conditions that may influence these behaviors are possibly an even more complex and heterogeneous category than the psychological variables, including as diverse elements as physical–structural conditions (e.g., home size, technologies, standards, and the format and frequency of information about the household's energy consumption), socio-demographic characteristics (household size and composition) as well as cultural and economic aspects (social norms and economic incentives). Contextual conditions influence home energy use and individual conservation behavior in a multitude of ways, including through the formation of outcome expectations (Black et al., 1985) and self-efficacy (Gist and Mitchell, 1992), but also directly by constraining available choice options and determining their attractiveness.

For example, it has been consistently found that the household's electricity consumption increases with the number of household members, household income, and the size of the home (Petersen and Gram-Hanssen, 2005). It is perhaps less obvious that also the age-composition of the household members contributes to the variation in overall household electricity consumption. In particular, it has been found that households with teenagers use significantly more electricity than other households after controlling for household size (Petersen and Gram-Hanssen, 2005). A less visible, but more pervasive kind of contextual condition is cultural understandings, which have been shown to have a profound influence on our perceptions of what is "right or wrong" and "necessary or unnecessary" consumption (e.g., Wilhite et al., 2001).

Attitudinal and contextual variables seem to have their main influence in different stages of the decision-making process. A review of US based studies found that attitudes are good predictors of intentions to change residential energy use behavior, but structural characteristics (of the residence) are better predictors of specific actions, such as weatherization (Guerin et al., 2000). In the next section, we synthesize these findings in a social-cognitive model of electricity saving behavior and electricity consumption.

3. A social cognitive model of electricity saving behavior and electricity consumption

The available evidence suggests that impeding contextual conditions and, related, low self-efficacy are some of the important reasons for the squandering of electricity in private households. Self-efficacy and (real and perceived) sociostructural conditions are key constructs in Bandura's (1986) social cognitive theory, which makes this theory a potentially useful frame of reference for the present study. It is also a comprehensive and therefore complex theory, which makes it difficult to operationalize. Hence, like most other empirical studies based on this theory (e.g., Bandura, 2004), we employ a simplified version, adapted to the specific behavioral problem at hand.

The core construct in Bandura's social cognitive theory is self-efficacy, which he defines as the person's confidence in performing a particular behavior. Bandura argues that behavior change is made possible by a personal sense of control. If people believe they can take action to solve a problem instrumentally, that is, if they have a sense of self-efficacy, they become more inclined to do so and feel more committed to the action.

Although behavioral research is usually most interested in determining how individual behavior is contingent on personal and environmental factors, Bandura (1986) emphasizes the reciprocal determinism between personal factors, environment (defined as factors physically external to the person), and behavior. For example, a person's sense of self-efficacy (a personal factor) is assumed to be an important antecedent of behavior *and* at the same time to be partly derived from his or her past behavioral experiences. This reciprocal determinism is illustrated by the dotted feedback arrows in the otherwise recursive representation of the core elements of the theory in Fig. 1.

What exactly the individual learns from past behavioral experiences depends on the reinforcements in the situations (defined as the responses to a person's behavior that increase or decrease the likelihood of reoccurrence). In addition to self-efficacy, the individual's expectations (the anticipated outcomes of a behavior) and the values that the person places on given outcomes are assumed to influence a person's goals and behavior.

Another key proposition in Bandura's theory is that individuals do not only learn from their own personal experiences, but also by watching others' behavior and the outcomes of others' behavior (i.e., observational learning). Such "vicarious experiences" are an

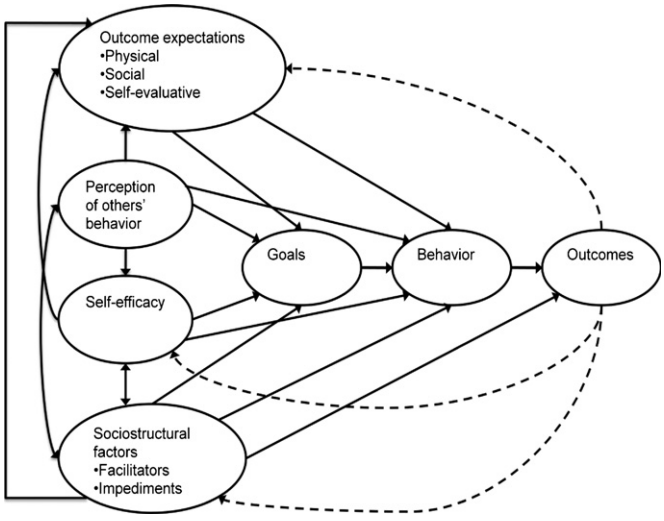

Fig. 1. A social cognitive model of behavior and learning. .
Source: adapted from Bandura, 1986